TIN No. 26—NEW SERIES.
U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF ENTOMOLOGY.

PROCEEDINGS

OF THE

TWELFTH ANNUAL MEETING

OF THE

ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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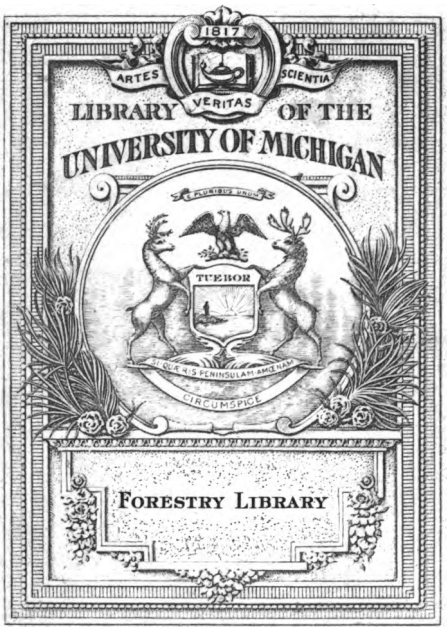

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., September 7, 1900.

SIR: I have the honor to transmit herewith the manuscript of the proceedings of the twelfth annual meeting of the Association of Economic Entomologists, which was held at New York City June 22 and 23, 1900. From the fact that the papers presented at the meetings of this Association are always of the greatest economic importance, the Department has hitherto published the secretary's reports as bulletins of this Division. I therefore recommend the publication of the present report as Bulletin No. 26, new series.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. JAMES WILSON,
Secretary of Agriculture.

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*Withdrawn for publication elsewhere.

TWELFTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

MORNING SESSION, FRIDAY, JUNE 22, 1900.

The Association met in room 618, Schermerhorn Hall, Columbia University, New York City, at 10 a. m., June 22, 1900.

The following members were in attendance at the sessions:

Vice-President C. P. Gillette, Fort Collins, Colo.; Secretary A. H. Kirkland, Malden, Mass.; A. F. Burgess, Malden, Mass.; R. S. Clifton, Washington, D. C.; J. H. Comstock, Ithaca, N. Y.; E. P. Felt, Albany, N. Y.; H. T. Fernald, Amherst, Mass.; James Fletcher, Ottawa, Canada; A. D. Hopkins, Morgantown, W. Va.; L. O. Howard, Washington, D. C.; W. G. Johnson, College Park, Md.; Trevor Kincaid, Seattle, Wash.; C. P. Lounsbury, Cape Town, South Africa; A. L. Quaintance, Experiment, Ga.; F. W. Rane, Durham, N. H.; E. D. Sanderson, Newark, Del.; W. M. Scott, Atlanta, Ga.; Franklin Sherman, jr., Ithaca, N. Y.; C. B. Simpson, Ithaca, N. Y.; Henry Skinner, Philadelphia, Pa.; E. B. Southwick, New York City; F. M. Webster, Wooster, Ohio; C. M. Weed, Durham, N. H.; C. W. Woodworth, Berkeley, Cal.

In the absence of President Bruner, Vice-President Gillette called the meeting to order, and asked Mr. Howard to take the chair.

Vice-President Gillette read the following address:

OBJECTS OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

By CLARENCE P. GILLETTE, *Fort Collins*, Colo.

No one regrets more than myself that our honored president and genial friend, Professor Bruner, has found it impossible to be with us on this occasion, or to prepare an address for our instruction and entertainment.

It is at the request of Professor Bruner and our worthy secretary that I am offering this hastily prepared substitute for a presidential address, that we may appear to live up to our constitution and time-honored custom.

While it is no small task that is placed upon me, I am mindful of the fact that it is no small honor to be permitted to deliver the opening address of the Annual meeting of this Association of earnest scientific workers—the first and only society of its kind in all the world. Particularly am I impressed with the honor when I remember we are met in one of the foremost seats of scientific learning in our country.

And then there is, perhaps, a sort of grim satisfaction in the feeling that it is my unquestioned privilege at this time to act the part of an adviser. I can praise you for your welldoing, scold you for your shortcomings, and inflict upon you my own ideas as to what your duties are to one another and to the people you serve. But, alas, how often we find that what we supposed to be a new idea or a new species turns out, after all, to be old. After reading again the addresses of former presidents of this Association, it appears that my supposedly new ideas have nearly all been "preoccupied." So I can not hope to offer much at this time that shall be considered new or worthy of specific rank.

Like a freeborn American citizen, I have decided to speak of the duties and privileges conferred upon us by section 2 of our constitution, which sets forth the objects of the organization.

It is well to pause occasionally in our onward career and ask ourselves why we exist. The founders of this Association had high and noble ideas as to what should be attained by its members. In recounting these objects it will be necessary to repeat much that has already been given in addresses of this nature, but will it not be better to urge the performance of duties that have already been recognized as such than to advance many new plans of work to be neglected and soon forgotten?

Section 2 of the constitution gives the objects of the Association in the following words:

> Its object shall be (1) to discuss new discoveries, to exchange experiences, and to carefully consider best methods of work; (2) to give opportunity to individual workers of announcing proposed investigations, so as to bring out suggestions and prevent unnecessary duplication of work; (3) to suggest, when possible, certain lines of investigation upon subjects of general interest; (4) to promote the science and advance the study of entomology.

The objects are well chosen and clearly and concisely stated. Let us consider them one by one.

We are "to discuss new discoveries." This implies, first of all, that new discoveries are to be made. It takes for granted that the members of this Association are to be scientific workers and not mere book students, content to thrash over old straw or to step exactly in the footprints of another. Each is expected, by his own careful research and study of nature, to add new facts to the sum of human knowledge. It is a noble aspiration for one to desire to leave as his legacy to the world some new idea or discovery to be of use to all succeeding generations.

Who could not "when his summons comes * * * wrap the drapery of his couch about him and lie down to pleasant dreams" if he could know he had brought such a blessing to his countrymen as the introduction of the Vedalia to the relief of disheartened fruit growers, or if he had made possible the successful culture of so valuable an article of food as the fig through the establishment of *Blastophaga grossorum* in American orchards, or if he were certain of having done anything during his lifetime of service that would be a sure and perpetual source of blessing to mankind?

You will recall that Dr. Fernald, in his presidential address, put the making of new discoveries first in importance in our work. In all science and in every industry it is the new discoveries that make further advance possible. They are the sure stepping-stones by which man ascends to greater heights and gets a broader view of the great world in which he labors. There are thousands to make use of a good thing when it has been discovered and made known to the world, but there is scarcely more than one in a thousand who can claim the distinction of really making a new discovery by which succeeding generations become his debtors.

Whether or not we have done all that might reasonably be expected of us in this regard I will not attempt to assert. I do believe we have lived up to this clause of our constitution as well as any. From infancy to old age, wherever a human being is found, it is as natural for him to announce to his fellows a discovery of something new to him in vision, in hearing, or in the realm of thought as it is for him to defend his person from an unfriendly blow or to take food when hungry. Galileo could no more refrain from telling the world that the earth moves than he could help breathing into his lungs the free air of heaven. Servetus, who first announced the continuous circulation of the blood, was not checked in the least in his determination to publish to the world what he believed he could demonstrate to be the truth, though he was fully warned of his probable fate.

All science is but a search after truth, and every fact established is a signboard for the guidance of all others that come that way.

It is no surprise, then, that many new discoveries have been made by the members of this Association, and that they have been promptly reported at these annual meetings or through station bulletins and entomological magazines.

The speaker believes it would be difficult to find so small a body of workers, with so meager an amount of time to be devoted to original research, in any other science, who can show larger results in the way of new discoveries in so short a time. So, while we endeavor to emphasize the importance of new discoveries, we believe there is reason to congratulate ourselves upon past achievements. Let these facts spur us on to greater endeavor, but let them not be to anyone a cause for resting upon his laurels.

How shall we proceed to the discovery of new facts? Is it sufficient to go about our duties with eyes wide open and minds alert, making discoveries at random here and there which have no close relation one to another? To make and chronicle any new discovery is well, but the difference between one who is simply a good observer and the scientific worker in applied entomology will be manifest in the fact that the latter will so plan and systematize his work that the facts observed and the conclusions reached will have an intimate relation one to the other and will form a basis for economic operations. While I believe the work in applied entomology is on a higher level in this respect than ever before, still there is room for improvement.

And then each should specially strive for those facts the possession of which will enable us to generalize and lay down working principles, or, as put by Professor Osborn in his address, "we should not neglect such underlying problems as shall perfect the fundamental knowledge of our science." One discovers that the male of a codling moth possesses a black stripe or dash on the underside of the fore wing which makes it possible to separate it from the other sex. It is a fact well worth recording and of importance to those who are working with the insect, but it has no underlying principle that enables one to draw important conclusions. To discover that the moth begins laying her eggs on the fruit about a week after the bloom has fallen; that the egg is about ten days in hatching; that the young larva usually enters the calyx of the fruit and there begins to eat into it; that the calyx of the apple closes within a few days after the petals fall, is to discover facts closely related to each other and which enable us to intelligently plan for the destruction of the insect.

In more than one presidential address we have been urged to put special stress upon life-history work. It is here particularly that we need new discoveries. Facts in life histories of insects must furnish a large proportion of the necessary basis for successful economic work. They are to the science of applied entomology what the laws of gravitation, of chemical affinity, and of the indestructibility of matter are to one who is to be an analytic chemist.

An examination of recent bulletins from experiment stations by the side of those that were published when this Association was organized will show that more and better life-history work is being done. Let us continue to improve in this important line of study and let us hear freely from all suggestions of new or better methods.

We should endeavor to choose those problems that are of peculiar interest, each in his particular State, or any important problem which others for some reason have shunned. Good examples of what I would urge are: The work being done by Professor Hopkins on the life histories of wood-boring beetles; the work of Dr. Forbes and others on insect diseases; the work of Professor Osborn upon the

Jassidæ, and of Professor Slingerland with the codling moth. Many good examples have been set us in this work by Drs. Riley and Howard and their able staff of assistants. There is this difference, however, in the duties of the Government entomologist. He must see that all portions of the country have a share of his attention, for he is the servant of all, and the publications from his office indicate that he is doing well his duty in this regard.

In this connection I will pause long enough to say that it is not necessary to take for study some new pest that has never been introduced to the world. Much of the very best work in the investigation of life histories has been with the old pests that we were supposed to know perfectly. Since the work of Messrs. Washburn, Card, and Slingerland upon the codling moth we almost feel that we now have a new insect to talk about to the fruit growers in our respective States. A thorough study of almost any of the long-known pests would doubtless bring out valuable new discoveries in habits, and result in the employment of better means of prevention or remedy.

But we are not simply to make and report new discoveries; we are to "discuss" them when we meet on these occasions. These discussions are not alone for those who are to learn for the first time of the new discovery. If one knows that whatever he reports here will be closely criticised by those who are present, he will be more careful to make sure of his conclusions before communicating them to the public, and the standard of our work will be raised to a higher level.

So let us bear in mind the words of Dr. Fletcher in his presidential address in 1891, wherein he urged that we discuss all our experiences freely and in an informal manner at these meetings.

Here, again, we have followed in a commendable degree the letter of our constitution. But discussion may do good or harm, depending upon the manner in which it is given; and there have been occasions when criticisms were not wholly in the friendly spirit which ought always to characterize them. Let our discussions never have any unnecessary bitterness in them. An adverse criticism, at the best, is not a pleasant morsel. If it is needed, let it come, but let it always come as of necessity. Make a child feel that his chastisement is necessary, that he has brought it upon himself, and that the infliction of it is a duty and not a delight, and you will not incur his estrangement or hatred by giving it, and he will take a deep interest in seeing that there shall be no occasion for its repetition. The usefulness of our organization, as of any other, depends upon united efforts and a feeling of brotherhood among its members.

Next, it is our duty, according to our constitution, "to exchange experiences and carefully consider best methods of work." Experience meetings are not monopolized by religious associations. They are equally important to the success of all organized effort. No one

can be a toiler in any special line for a year without encountering experiences that might be related to a fellow-laborer to his profit. We are scattered over a large territory, having widely varying conditions of climate, altitude, and plant and insect life. Each can bring from his particular field some points of peculiar interest to all the others. While we may read one another's publications and perhaps exchange frequent letters until we almost feel acquainted, it is only occasionally that we can enjoy these meetings together, and it is a great inspiration to talk freely over one's experiences and plans of work face to face with those who are interested with him in similar lines of labor.

The student of applied entomology is supposed to have a good general knowledge of agricultural affairs, particularly in regard to plant growth. He must be informed upon all the insecticide materials and be able to tell what insects they are suited to kill, in what strength they may be applied to different plants, what their physiological effects will be on both plant and insect life, and when they can best be applied. He is supposed to be able to tell at a glance what any insect is that may be handed him, and whether or not it is injurious or beneficial. He is expected to be able to recommend the cheapest and best pumps or other machinery for the application of insecticides. Is it any wonder that we need to get together and exchange experiences and discuss methods of work, particularly when we remember that different results are obtained in different localities? Lime, salt, and sulphur, so valuable for the destruction of San Jose scale on the Pacific coast, was found to be of very little value in the moist atmosphere of the eastern portion of the country; the codling moth, said to have one brood in Maine, is reported to have two in Colorado, and three or four in other places; insects fairly common but never seriously abundant in one portion of the country are often found to be great pests in others. In view of these conditions it is important that we obtain all the ideas possible from fellow-laborers in different localities, that we may make as few mistakes as possible, and that we may not bring down upon ourselves the distrust of those whom we labor to benefit.

We are also "to consider best methods of work." Method is always important, and particularly is it to be sought for in a young science or industry where long experience has not yet determined the best plans of procedure. It was well at first that a large amount of individuality should enter into the work and a variety of methods be employed. Then, by a process of natural selection, the poorer methods would gradually drop out and the better ones be retained. It is time for this Association to lay aside its swaddling clothes and assume the garb of maturer years. It should be one of its objects to determine upon best methods as soon as expedient to do so. One recommends Paris green or London purple in the proportion of 1 pound to 200

gallons of water, while another will make it 1 pound to 160 or even 100 gallons for the destruction of the same insect. One recommends two sprayings for the codling moth, another three, and another says spray often enough to keep the fruit covered with a layer of the poison, so as to be sure of killing the second brood. Some advise hellebore for the pear slug, while others prefer one of the arsenites; and still another would use quicklime or simply road dust. Surely there is need of more method and uniformity in our work and in our recommendations for the control of particular insects. By free discussions at these meetings much can be accomplished to this end.

This consideration of "best methods of work" as well as the object expressed in the next clause, namely, "to give opportunity to individual workers of announcing proposed investigations, so as to bring out suggestions and prevent unnecessary duplication of work," brings upon us the importance of systematic cooperation in our investigations. Cooperation has been urged upon us at many of the meetings of this organization, but I do not see that much progress has been made in that direction. I am strongly impressed with the feeling that we are falling short of our possibilities by neglecting to cooperate more in our work. It may be best to hold to some very restricted line at first, and then experience will indicate other and broader methods.

Probably one of the chief difficulties of cooperative work is that each wishes to plan his own experiments and publish the results; then he does not have to share honors with another. Such a feeling is not altogether to be condemned. Neither is it necessary to so plan our cooperation as to make it essential to remove credit from him to whom it belongs. Let us suppose two entomologists are planning independently to test the effect of insecticides upon foliage. Each carries through his experiments and publishes the results of his labors. They are still independent experiments, the results of one not supporting or contradicting to any great extent the results of the other. Had each known what was being planned by the other, they could have arranged to carry out their experiments so that they would be largely duplications of each other, and when the results were published we should have double evidence upon the points under consideration where results agreed; and where they disagreed, we might be able to find in the different conditions the reason for it. Such a cooperation would bring results of far greater value than those obtained by independent experimentation, and neither party would lose any glory; in fact, each would receive more credit because of the better conclusions that could be drawn from the work. And then how carefully every conclusion would be reached and backed by positive proof for fear that the other party might get different results! Such duplication as this is of the utmost importance to establish scientific truth, and

the more we can have of it the better. It is only the "unnecessary duplication of work" that our constitution deprecates.

It is frequently the case that one is working out with considerable care the life habits of an insect, and a little information from exact observations upon some particular point in other localities would be of great service to him. The person giving the information would have full credit for what he did, and the world would have the benefit of the combined results. When time can not be taken by the head of a department for this aid, it may often be the case that a special student in entomology would be glad to get his name into a bulletin for doing a little good work. I have a case in mind to illustrate. The speaker is working on the life history of the codling moth. His observations make him wonder how it can be possible that there can be so few as one brood or so many as three or four anywhere. He would be greatly aided if a few entomologists in different parts of the country would make the following observations and report results this year. First, obtain date of blooming of the earliest apple trees. Second, determine the time of appearance of the first moths of the second brood by collecting a few of the earliest wormy apples and rearing the moths from them. Third, determine when the brood of worms that go over winter without pupation begin to leave the fruit. This can be done by placing cloth bands on the trees about July 15, and removing the larvæ that appear under them once a week until those have been taken that do not change to a chrysalis within a short time. Then, with the other facts that have been well worked out, it will be possible to state with considerable definiteness the number of broods in different portions of the country.

There is one other of the many opportunities for cooperation to which I wish briefly to call attention. So far as possible every station entomologist should build a collection representing the insect fauna of his State. In addition he should get together as complete a collection as possible of the injurious and beneficial insects of the whole country. The value of such a collection I do not need to urge upon you, as it will be admitted by all. I wish it might be determined by secret ballot in this meeting just how many out of a dozen of our worst pests that I might name are represented in the collections belonging to the different stations. I would not dare to ask you to reply verbally for fear it might be embarrassing. And then you might turn about and ask me to answer my own question. Don't any of you blush while you try to recall how many of the following species you can show to an inquiring friend: *Blissus leucopterus*, *Carpocapsa pomonella*, *Melanoplus spretus*, *Cecidomyia destructor*, *Coccotorus prunicida*, *Typhlocyba comes*, *Tinea pellionella*, *Cicada septendecim*, *Scolytus rugulosus*, *Psylla pyricola*, or even *Aspidiotus perniciosus* and *Aspidiotus ancylus*. If you are fortunate enough to have the two last named, can you tell

them apart, or could you distinguish them if sent for determination? No reply is expected. Not one of these important species should be absent from any of our collections. By a little cooperative exchange we might all have them, along with many others.

The accumulation of the State fauna each must look after for his own region, but the general economic collection can be made only through some sort of cooperation. There are a large number of serious pests in rather restricted localities which should also be represented in all economic collections so far as possible. In Colorado the bean beetle (*Epilachna corrupta*) is as bad on the wax beans as is the potato beetle on potatoes; the fruit-tree leaf-roller (*Cacœcia argyrospila*) I have known to entirely defoliate whole orchards, and its close relative, the box-elder leaf-roller (*Cacœcia semiferana*), is equally destructive to the foliage of the box-elder; the currant and gooseberry fruit fly (*Epochra canadensis*) sometimes destroys three-quarters of the gooseberry crop, and the plum gouger (*Coccotorus prunicida*) punctures fully nine-tenths of our plums on the eastern slope, and still it would not be surprising to learn that in many of the States not one of these pests is represented in the station or agricultural-college collections. This does not seem right.

If the best way to build up our collection is by individual exchanges, then let us follow that plan. If we can adopt some general method and all work to it, let us do that. It seems to me this is a good problem for a committee to work out for us. In any case, let us all collect large series of duplicates of those insects that are specially injurious or beneficial in our different localities, and then endeavor by some plan to better our economic collections, and those of other States, through exchanges. I should be glad to hear of any who would like to have Colorado's injurious and beneficial insects in their collections and are willing to exchange species from other States for them. And then, it is often important to have the same species from different localities to note variations.

Let us talk freely of our plans, and let us hear suggestions from any and all in regard to methods and lines of investigation that seem to you to be specially important. In this way we shall broaden our horizon and get a larger view of the scope and importance of our work.

The next object as stated in our constitution is "to suggest when possible certain lines of investigation upon subjects of general interest." Such work would in large part be cooperative, but not entirely so. Nothing, perhaps, would be of more general interest than information and suggestions as to best methods of putting information upon applied entomology into the hands of the common reader. To what extent is it advisable to use the newspaper and the press bulletin? Is it best to put out bulletins in two series, one for the farmer and one for the station worker and specialist? Shall we publish all data from

which our conclusions are drawn, along with the bulletin to be sent to the general reader, or shall we publish in bulletins results only, and reserve tables and other exact data for publication in annual reports?

We are all interested to know to what extent the various horticultural inspection laws are efficient in the States passing them. What portions are specially valuable, and what portions do you consider of little or no use? Further laws are to be enacted the coming winter, and we want to know what to recommend in our various States in regard to them.

Lastly, we are "to promote the science and advance the study of entomology."

The usefulness of any applied science depends upon man's knowledge of the natural laws operating in that science. An astronomer could not determine the very day, hour, and minute when an eclipse of the sun would be visible at a particular spot on the earth's surface, or the exact date of the return of a comet, if he did not thoroughly understand the operation of the laws by which these marvelous phenomena are brought about. Neither can applied entomology accomplish its highest mission in the world for man's benefit until he succeeds in thoroughly working out and interpreting aright the laws which prevail in the insect world, and they are many and intricate, and some of them difficult of solution. Whatever we can do to interest others in the study of insect life in any of its phases, to the end that new facts are recorded, will help to the more perfect understanding of our favorite science and consequently to its usefulness. We are greatly indebted to the pure systematist in entomology who never attempts to make a practical application of his knowledge.

It would greatly promote the science of entomology if each member of this Association would make a special systematic study of some group of insects, however small, and publish the results as a personal contribution to the pure science of entomology. We would be better workers in economic problems for so doing. A study of the habits of insects in nature's laboratory fits one for a grade of systematic work that he never could attain as a closet naturalist.

A knowledge of food plants, of broods, of local variations, and of variations occurring among the offspring of a single pair, determined by careful observation in nature's haunts or by breeding in the laboratory, is as essential to enable one to establish true specific differences as is a thorough knowledge of structural character.

To promote a science it is necessary to make known its relations to human interests. If men can be shown that their health, wealth, or happiness depends upon a knowledge of insect life, there will be no trouble to interest people in the study of entomology. Show the farmer, the gardener, and the horticulturist the importance of knowing the habits of insects in order to successfully combat the pests that

destroy their crops; bring to the attention of the preacher the inexhaustible fund of evidence and illustration with which to teach his flock the power, wisdom, mercy, care, and omnipresence of the Creator of all; make known to the artist the boundless field which a study of insects opens to him for the display and development of his powers in portraying graceful and fantastic forms and in preparing and blending colors of the most exquisite beauty and harmony; teach those who instruct the young what a wealth of interesting and easily obtained objects are always at hand from insect life with which to fascinate the child and secure his lifelong interest in natural history study; make it plain to all that the very laws of life that prevail in the higher realm are equally patent among the creeping, crawling creatures of lower rank and smaller size—do all this, and the science of entomology will quickly take the rank it deserves among its sister sciences.

In closing let me urge that we keep in mind the worthy objects for the promotion of which we are banded together. Let us keep the standard of work up to the ideal conceived by those in whose minds the organization had its birth. Let us show a willingness to sacrifice self-interest when it is necessary for the general good, and let us do all in our power to preserve and strengthen the fraternal feeling that has ever existed among our members.

Mr. Weed moved a vote of thanks to Mr. Gillette for his interesting and suggestive address, the motion being seconded by Mr. Johnson and carried unanimously.

Before leaving the chair, Mr. Howard called attention to the fact that it had been the custom to postpone discussion of the presidential address until the afternoon session, in order to have a short time for the transaction of business.

Reports of the secretary and the treasurer were read and, on motion of Mr. Webster, were accepted.

Mr. Howard moved that a committee of three, to include the chairman and the secretary, be appointed to prepare a programme for the rest of the meeting.

Mr. Johnson suggested that, in view of the fact that the Association was to join with the Society for the Promotion of Agricultural Science on the following day, the committee of three be instructed to consider that programme also.

The motion was adopted and a committee consisting of the chairman (Mr. Gillette), the secretary (Mr. Kirkland), and Mr. Weed was appointed and requested to meet immediately on adjournment.

Mr. Howard moved that the secretary place on the list of members the names of Frank Benton, Richard S. Clifton, and August Busck, all of Washington, D. C.

Mr. Hopkins proposed the name of Trevor Kincaid, of Seattle, Wash.

Mr. Webster proposed the name of Wilmon Newell, of Wooster, Ohio.

Mr. Woodworth proposed the name of Carroll Fowler, of Berkeley, Cal.

Mr. Fernald proposed the name of C. M. Walker, of Amherst, Mass.

Mr. Howard moved that a committee on officers for the next meeting and also a committee of three on resolutions be appointed to report on the following afternoon.

The motion was carried and the chairman announced that the committees would be appointed later.

Mr. Howard then presented a paper on:

PRESENT CONDITION OF THE BLASTOPHAGA IN CALIFORNIA.

By L. O. Howard, *Washington, D. C.*

In this paper the speaker detailed the operations in the introduction and establishment of Blastophaga which had been carried on since the last meeting of the Association. As a fuller and later account will be published in the Yearbook of the U. S. Department of Agriculture for 1900 the paper presented is not published here.

ESTABLISHMENT OF A NEW BENEFICIAL INSECT IN CALIFORNIA.

By L. O. Howard.

[Abstract.]

A second note presented by Mr. Howard also related to the introduction of a beneficial insect. He stated that it would perhaps be remembered that at the tenth annual meeting of this Association he had referred to his efforts to introduce and establish in this country, with the assistance of Prof. Antonio Berlese, of Italy, the interesting Oriental parasite known as *Scutellista cyanea* (see Bulletin 17, n. s. Div. Entom., U. S. Dept. Agric., pp. 13, 14.) In Italy this curious parasite occurs commonly in the wax scale (*Ceroplastes rusci*), and it was introduced into Italy in all probability from the Orient about forty years ago, although originally described by Motschulsky in 1859 from specimens reared by Nietner in Ceylon from *Lecanium coffeæ*. The living specimens were sent by Dr. Berlese and his colleague, Dr. Leonardi, and were colonized at Baton Rouge, La., through the courtesy of Prof. H. A. Morgan and Prof. S. E. McClendon; also in Washington, D. C., in the insectary of the Division of Entomology upon *Ceroplastes cirripediformis*. The Washington specimens did not

succeed in perpetuating the species and nothing has been found since of the Louisiana material. A year later Mr. C. P. Lounsbury, government entomologist of Cape Colony, found this species parasitic upon *Lecanium oleæ*, the common black scale, in Cape Colony, and sent specimens to the writer for identification. The past spring, Mr. Lounsbury, at the writer's request, made formally through the United States Secretary of Agriculture to the Secretary of Agriculture of Cape Colony, brought with him from Cape Town to New York two boxes of twigs covered with the black scale affected with this parasite, and expressed them to Washington, whence they were immediately forwarded to Mr. E. M. Ehrhorn, the horticultural inspector of Santa Clara County, Cal. On June 19 the writer received a letter from Mr. Ehrhorn announcing the arrival in living and healthy condition of the parasites in question. The twigs in one box were somewhat moldy but quite a number of parasites were crawling about in the box and were found in the pupal condition in some of the scales. Mr. Ehrhorn had been warned by telegraph and had prepared twenty-five infested oleander plants by potting them and had covered each with a tight bag of the finest Swiss muslin. In these most of the parasites were liberated and a few were allowed to fly in the orchard. Specimens of a hyperparasite (*Tetrastichus* sp.) also survived the journey, but Mr. Ehrhorn was on the lookout for this parasite and isolated them as they appeared, pending instructions from Washington as to their destruction. The writer had strong hope of the successful establishment of this species at San Jose, the climate being appropriate and the supply of food unlimited, and stated further that this was another instance of international entomological work which emphasized the fact that this Association through this class of work binds together its members all over the world more than any other association.

BENEFICIAL WORK OF HYPERASPIS SIGNATA.

By L. O. Howard.

[Abstract.]

In a third note presented by Mr. Howard he stated that at the meeting of this association held in 1898 he had the pleasure of calling attention of the members to the rehabilitation of *Pulvinaria acericola* Walsh and Riley, a Pulvinaria which occurs upon the leaves of maple. The full life history of this species and also of that of *Pulvinaria innumerabilis* were displayed in Bulletin 22, n. s., of the Division of Entomology, U. S. Department of Agriculture. Under the head of natural enemies of both species the little ladybird beetle, *Hyperaspis signata*, was especially mentioned and the statement was made that it was received in the larval state from Knoxville, Tenn., feeding upon

the scale. On June 18 of the present year an additional lot of specimens upon maple leaves was received from Prof. Hunter Nicholson, of Knoxville, Tenn., and with them numbers of the larvæ of the Hyperaspis feeding energetically upon the eggs of the scale insect. Drawings were made of this very peculiar and characteristic larva which are reproduced herewith. The striking likeness of the larvæ of the Hyperaspis to a mealy bug will at once be noticed. Were it feeding upon mealy bugs instead of upon Pulvinarias (and it frequently does feed upon mealy bugs) it would at once be evident that

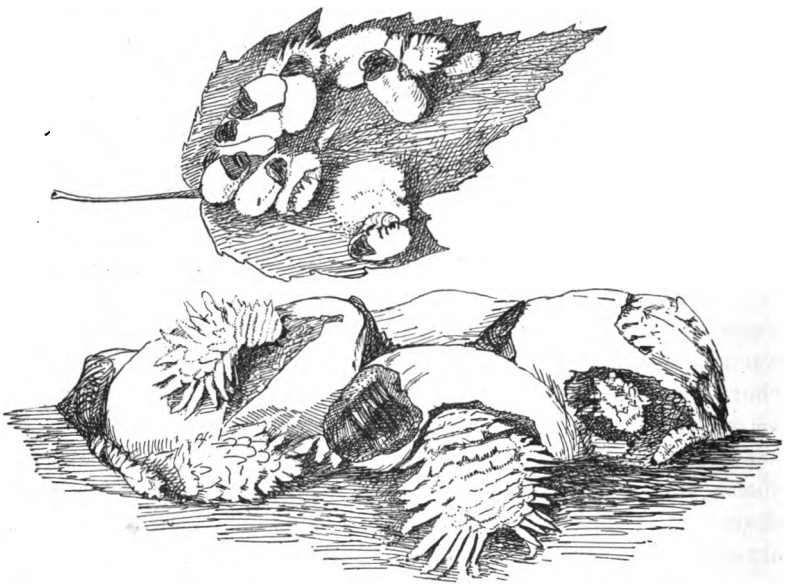

FIG. 1.—*Hyperaspis signata:* Larvæ feeding upon Pulvinaria on leaf of maple above, natural size; below, enlarged (original).

we have here a clear case of what Professor Poulton calls "aggressive mimicry."

Mr. Gillette expressed the wish that the Association might have more talks like Dr. Howard's, and asked if there were any questions or suggestions.

Mr. Howard said he would be glad to hear from Mr. Lounsbury on the subject of the parasite of the black scale. He said he wished to add that Mr. Lounsbury had sent two boxes—one a deep box and one a shallow box. The shallow box carried the more successfully. The scales had begun to rot in the deep box.

Mr. Lounsbury replied that he was more in quest of information than anxious to give it, and would like to know if anything had been done about the secondary parasites,

Mr. Howard stated that a number of secondary parasites of the genus Tetrastichus had issued, but Mr. Ehrhorn was forewarned and isolated them as fast as they emerged, so there was no danger.

Mr. Lounsbury stated that the history of the case dated back to his first arrival in Cape Colony. Before he had been there a year he noticed that the black scale was not injurious, and upon traveling about the Colony he found the same condition true over many thousand miles of territory. Later, upon obtaining specimens of the parasite and corresponding with Mr. Howard on the subject, the latter had sug gested his sending it to California. For four years he had been watching for an opportunity to get a sufficient number of parasites to send, but the scale is so well kept in check by the parasites or by other factors that until this year he was unable to find a large quantity. Last year he mentioned the matter in his annual report, a copy of which he had sent to Mr. Ehrhorn, who at once wrote and asked him to take steps to get the parasite established in California. He replied that he would gladly do all he could, but would like Mr. Ehrhorn to make it a formal matter so that he might be able to spend the time and money necessary. This was done and Mr. Lounsbury received formal orders to go ahead. He set about in two ways: First, he had scales collected and reared young larvæ from them, which were placed on young oleander trees now being kept in the Cape Town gardens. Primary parasites were to be admitted to the plants, but secondaries excluded. These plants in time he may be able to send to the United States in Wardian cases. Second, while waiting for these to develop he had Mr. Mally go out and search the country side, with the fortunate result that relatively large colonies of scale were found where Mr. Lounsbury had seen small colonies the year before. Mr. Mally collected for nearly a week and brought in over a bushel of twigs which were carefully sorted, cut into foot lengths, and the ends dipped into sealing wax. The twigs were then wrapped in tissue paper. The matter of the differently shaped boxes was purely accidental. He went to the grocery shop and picked out what he thought would be best suited, taking one shallow box and one deep box in order to try them. He thought that packed in the manner above described and placed in a wooden box what moisture came would be absorbed by the wood. The boxes were packed the night preceding Mr. Lounsbury's departure, the deep box being placed on a dry shelf in the fruit room of the Cape steamer and the shallow box kept in his stateroom. In this way the insects were taken to England, which he hurried across and took the next liner. He then tried to get the box which he had kept in the fruit room also placed in a cool room on the New York steamer, but found no choice between putting it in the meat room or leaving it outside. He preferred not to freeze the insects because the parasites not being accustomed to such temperature might succumb, and he therefore placed

the box in an empty cabin below the water line. The voyage was fortunately cool, the temperature averaging about 60°. The shallow box was kept in his stateroom, as on the Cape steamer, and immediately upon arrival at New York both boxes were shipped to Mr. Howard. They arrived in New York in twenty-five days from Cape Town, a quick passage which, perhaps, could not be repeated. Mr. Lounsbury further stated that on first writing to Mr. Ehrhorn the latter took the letters to Mr. Leib, a fruit grower, and Mr. Leib in some way put the matter in operation. Mr. Lounsbury wrote to Mr. Leib and said he would try to make a success of the matter, and advised him to get oleander plants and infest them with black scales and have things so arranged that he could put the plants under cover. He suggested further to Mr. Leib that if he should receive a sending of parasites on cut twigs the boxes should be opened in a closed room so as to allow the parasites to fly to the windows. This was the only way that occurred to Mr. Lounsbury for the removal of the secondary parasites. The primaries were to be collected and then liberated with the scale-stocked oleanders. As regards the oleander plants to come later, he had planned to prevent secondary parasitism, which he thought would be better if it could be carried out.

Mr. Lounsbury asked if there had been much experience to show the best method of sending parasites, and if it would be well to freeze them? He knew before he left Cape Town that the parasites in question would keep emerging for a month in closed jars in his office.

Mr. Howard replied that he did not think we could say yet what is the best way. One thing is certain, however, and that is that tin boxes should never be used in sending from the Tropics.

Mr. Gillette asked if it is quite certain that the Blastophaga is only three brooded in its native home.

Mr. Howard replied that they have lost track of the insect in its native home during a period of about two months and there is a possibility that there may be in certain places in Mediterranean regions a fall brood. The condition of their knowledge over there is more or less incomplete.

Mr. Johnson asked if the black scale in South Africa is destructive to citrus trees to the same extent as in California.

Mr. Lounsbury stated that he had seen citrus trees infested in only about ten places in the last five years in South Africa, and never more than a few scales at any of these places. Occasionally he had seen the scale on citrus trees from Natal or from Australia which had been imported to the Cape. One orchardist having several thousand trees said he had seen a little on his Australian trees, but it had disappeared. Mr. Lounsbury was unable to find any there after a year from the importation.

Mr. Fletcher asked of what country the scale is a native.

Mr. Lounsbury replied that he did not think it is known. The scale must have been in Cape Colony for many years and is not confined to citrus trees. It occurs most commonly on oleander and myroporum. He had found it 150 miles inland and on numerous indigenous plants away from settlements.

Mr. Johnson asked whether the parasite is solely responsible for the reduction of the scale in the orchards, and whether oleander is grown in South Africa as it is here, under glass.

Mr. Lounsbury replied that oleander at the Cape is an outdoor plant. He could not say positively that the scale is held in check solely by the parasite. It comes and goes, and is never very abundant. Only twice has he been shown by a farmer the scale on citrus trees.

Mr. Johnson, referring to Mr. Howard's description of the covering of fig trees much in the same way that Vedalia was covered in order to keep the figs on the trees, asked if it is necessary for the fig to remain upon the tree in order that the parasites may be carried through the winter with it.

Mr. Howard said that he assumed so.

Mr. Johnson suggested, from what he had seen of the condition in which the fig winters, that it might be possible to take figs at certain times from the trees and thus keep the insect through the winter. If this could be done it would do away with the outdoor covering. Whether or not the figs could be kept through the winter under certain conditions is well worthy of trial. While on this topic of parasites he desired to state that he had recently received a communication from Mr. Ehrhorn, in which the latter asked for parasites preying in the East on the imported cabbage worm. It seemed to Mr. Johnson that this was a matter for cooperation, and he merely mentioned the fact as a suggestion from Mr. Ehrhorn that it is very desirable to establish such parasites in that section. He had promised to do what he could from his end of the line, and he hoped that others who were fortunate enough to possess such parasites would also assist. He had also received a request from Professor Morgan for specimens of the parasite which he had bred and which Mr. Howard had named. Professor Morgan is anxious to colonize this parasite on *Murgantia histrionica* in Louisiana, and Mr. Johnson had promised to send him parasitized eggs of the harlequin cabbage bug at the earliest opportunity, but up to the present time had been unable to find any specimens of this destructive pest. Three years ago it was one of the most destructive insects in the Maryland and Virginia cabbage-growing sections, but since the freeze of February, 1899, he had seen very few specimens. He was unable to say whether this was due entirely to the freeze or to the parasites. The parasite is a new species (*Encyrtus johnsoni* Howard, Can. Ent., Vol. XXX, pp. 17, 18) and there seems to be some promise of its successful introduction into the South.

Mr. Gillette said he considered the matter of parasites one of great interest, and he hoped the subject would be further discussed. In Colorado nature often seemed out of balance. There are a number of species which are not abundant in the East, but which are very injurious in Colorado, and he thought it was because the parasites have not been carried to that section of the country. In his opinion it would be of the greatest benefit to certain portions of the country to introduce insect enemies, both parasitic and predaceous.

Mr. Howard said he desired to call the attention of the members of the Association to the fact that this was the most representative meeting of the Association ever held. Not only was Mr. Woodworth, of California, present, with Mr. Fernald, of Massachusetts, Mr. Weed, of New Hampshire, and Messrs. Quaintance and Scott, of the Southern States, but also "our dear old friend," Mr. Fletcher, of Canada, and Mr. Lounsbury, who had carried American economic entomology clear across the Atlantic Ocean to South Africa. Mr. Currie, the under secretary of agriculture for Cape Colony, who was recently visiting Mr. Howard in Washington, had said that he was very glad indeed that he had sent for an American entomologist to come to the Cape, and congratulated his department upon being able to secure such a man as Mr. Lounsbury. Mr. Howard further stated that while on this discussion of scale insects it was well to call attention to the fact that there was present in the room the man who first started the study of scale insects in this country—Professor Comstock, of Cornell University—and he suggested that Professor Comstock be called upon to say a few words.

Mr. Comstock stated that his knowledge of scale insects was a matter of ancient history. It was fifteen years since he had been drawn away from their study by other duties. Now when scale insects are sent to him, as they are very often, he sends them to Mr. Howard. He was very glad to meet with the Association, but regretted that he was in bad health and probably would not be able to remain through the sessions. So, if he was not present at the meetings it was not because his heart was not with the Association.

Mr. Felt then presented the following paper:

SOME EFFECTS OF EARLY SPRING APPLICATIONS OF INSECTICIDES ON FRUIT TREES.

By E. P. Felt, *Albany, N. Y.*

We have heard considerable in recent months about the value of crude petroleum as an insecticide, and one entomologist has stated, in giving his conclusions regarding its effects on fruit trees, that this substance "is harmless to the most tender varieties and on the youngest trees." There is no doubt but that crude petroleum possesses valuable properties, but in the light of results obtained in the

vicinity of Albany, N. Y., the assertion quoted is too sweeping in its character.

This spring a series of tests were begun with the avowed purpose of learning the best method of controlling the San Jose scale in orchards. During the progress of this work trees were treated with mechanical mixtures of water and kerosene and with crude petroleum in a similar manner, using 20 and 25 per cent of the oils, which were applied with a Gould's kero-water sprayer. A few trees were treated with undiluted kerosene and others with undiluted crude petroleum. A number of trees were treated with whale-oil soaps. Leggett's Anchor brand and Good's caustic potash whale-oil soap No. 3 were each used at the rate of 2½ pounds to a gallon of water. A combination of whale-oil soap and crude petroleum was also used on a number of trees, the proportions being 1 pound of the soap to 4 gallons of water and to 10 gallons of the soap solution 1 gallon of crude petroleum. A kero-water sprayer was on the ground and it was therefore easier to prepare the soap solution and arrange the apparatus to deliver 10 per cent of crude petroleum. This produced an emulsion as it passed through the nozzle. In addition to these, 12 trees were treated with hydrocyanic acid gas, using from 1 pound of the cyanide to 75 cubic feet to 1 pound to 150 cubic feet of space. The spraying was mostly done on April 11, though the fumigation was delayed until the 19th to 21st of April, at which time the buds had started some. This work was performed in a mixed orchard of over 100 young pear, peach, plum, and cherry trees, where the San Jose scale had been for about eight years, and the trees presented, therefore, every degree of infestation. Unfortunately, it was necessary to confine the use of the undiluted kerosene and crude petroleum to the worst infested trees. It is yet early to pass upon the effectiveness of these substances as insecticides and, therefore, only the effects on the trees will be considered at this time.

The spraying with the insecticides occurred just before the buds began to open, and with the exception of the trees treated with undiluted kerosene or crude petroleum very few or no harmful effects were observed. Examination of the experimental orchard eight days after spraying, showed that as a rule the trees were budding out. Those treated with kerosene gave little indication of the presence of the oil on the bark, while the dark color of those treated with crude petroleum was very apparent, a condition which persisted till June 20 at least. The whale-oil soaps showed to a considerable extent, the bark of the trees treated with Good's being moist, while many of those sprayed with Leggett's showed a white incrustation. The harmlessness of a mechanical 20 per cent kerosene emulsion applied at this time is well shown in the cherry tree No. 3, photographed May 12 while in full bloom. Tree 15, a Seckel pear, photographed May 14, shows well the harmlessness of a mechanical 20 per cent crude petro-

leum emulsion. Similar photographs could be shown in the case of 25 per cent mechanical emulsions of both kerosene and crude petroleum. But when we come to examine the results obtained with the undiluted oils, even after making allowance for scale injury, one can not resist the conclusion that both kerosene and crude petroleum may cause serious harm. Pure kerosene was considered by the owner of the orchard as dangerous material to use on a tree, and on that account but three trees were sprayed with it and all of them were in very bad condition from scale attack. The Howell pear tree No. 21 was sprayed April 11, photographed May 14, and was quite badly infested with the scale. At this latter date most of the tips of the limbs showed few leaves, and there were very few blossoms. The tree had evidently suffered considerably from the scale, and it is probable that the kerosene also injured it. June 20 the foliage of this tree had developed considerably, and while there were a number of dead branches, the suckers thrown out may eventually fill the vacant places.

It is with the crude petroleum, however, that the most marked results were obtained. The seckel pear, No. 101, was photographed May 12 and shows well the very few undersized, pale leaves. June 20 there were only a few bunches of leaves on four limbs, and a number of adventitious buds were developing. The foliage at this time was light in color. This tree was badly infested with San Jose scale, but, making due allowance for that, it is still far from what it should be. The Lombard plum tree, No. 93, was photographed May 12 and shows very well the effects of a spring application of crude petroleum. This tree was but moderately infested with the scale, and consequently most of the injury can be charged to the treatment. Only the stronger buds near the tips of the branches stood the test well. Many of those on the side branches were killed and others much weakened. The 28th of May I made the following note concerning this tree: "Leaves out considerably, but the folliage is still much thinner than on other trees of its kind." June 20 it was still seen that the foliage was thinner than the normal. The next tree, a Botan plum, was apparently in the same condition as No. 93 at the time of spraying, but on May 28 there was just one weak leaf, and a few of the apparently dead twigs showed a little green beneath the bark. Later the owner dug the tree out as dead.

Applications by horticulturists or farmers are worthy of close attention, because they are made more nearly under usual conditions. I was therefore very glad to avail myself of the opportunity of watching closely the results obtained by one. The extensive and abundant infestation of his young orchard with the San Jose scale led Mr. L. L. Morrell, of Kinderhook, N. Y., to try crude petroleum. Some young tree tops worked with Sutton Beauty were sprayed April 1 with 25 per cent mechanical mixture of crude petroleum, the trunks having been

previously painted with the oil. The grafts were 2 or 3 feet long, and had undoubtedly been severely injured by the oil. The lateral buds were dead in many cases and the foliage looked weak and sickly May 21. Since then portions of these trees have died. The killing of lateral buds was also noticed by Mr. Morrell on other trees sprayed with about this proportion of crude petroleum. The foliage was very thin, many of the lateral buds were killed, and the leaves were small and unhealthy. Writing June 20, Mr. Morrell states that with very few exceptions the trees painted with crude petroleum in the middle of February are looking well, some having some fine fruit on them. The most striking result was seen in three King trees painted by this gentleman with crude petroleum December 1, 1899. One of these King trees was photographed May 21, and was then nearly dead. June 20 Mr. Morrell stated that these trees are dead so far as one can see.

These facts show that crude petroleum may seriously injure trees under certain conditions. The trees may eventually outgrow the harm, and it is possible that the injury would be no greater than the scale would cause if allowed to go unchecked. The foregoing shows that the injury to the tree is less the later in the spring the application is made, provided the buds have not opened. The mechanical dilutions of crude petroleum, at least up to 25 per cent, appear to be harmless if applied before the buds open, and it is hoped that they will prove effective in controlling the scale.

A general discussion followed the reading of Mr. Felt's paper.

Mr. Gillette considered the subject one of great importance. In Colorado a number of people had sprayed in the early spring with crude petroleum because of the recommendations seen in newspapers. He asked if others present had tried crude petroleum, and if so, with what results.

Mr. Scott said that in Georgia he had carried out experiments along this line in February and March on peach and plum trees, about 3 barrels of crude petroleum purchased from the Standard Oil Company being used, at from 20 per cent up to the pure oil. He found that pure crude petroleum killed peaches and plums outright.

Mr. Felt asked when the oil was applied.

Mr. Scott stated just before the fruit buds opened in the spring. Fifty per cent and less strength did very little damage, but the best results were obtained with 25 per cent in mechanical mixture with water sprayed with a Gould kero-water sprayer. He also used 30 per cent, which did no damage to the trees and was quite effective in destroying the scale, but a mixture stronger than 25 per cent seemed unnecessary, as all the insects reached by the spray were killed accord-

ing to notes made up to June 12. Until that date the sprayed trees remained oily and the odor of the crude petroleum could yet be detected. It is a reasonable conclusion, then, that the scale can not live so long under such a coating of oil. He had concluded that the 25 per cent crude petroleum in mechanical mixture was better than refined kerosene of the same strength.

Mr. Woodworth said that when the bulletin from the New Jersey Station came out it was heralded all over California, and he had to write more letters in regard to the kerosene and crude-petroleum treatment than about any other insecticide. Crude petroleum in California is a very indefinite term, since there is a crude petroleum from Ventura which is as thick and black as molasses, and from that it varies to crude petroleum which is almost as thin as gasoline. Even in a single well the product varies according to depth and age, and distillations show that it varies greatly in composition. He had been assured that the Eastern product varied also, and was of opinion that before we can recommend any percentages of crude petroleum we will have to establish a criterion of excellence. The different kinds of crude petroleum he had experimented with in California produced very different results—strikingly different. There is also a very decided difference in results according to time of spraying with the same oil. Thus spraying before rain and after rain may produce entirely different results. He had sprayed with some forms of crude petroleum without injury which would have thoroughly destroyed the foliage at another time of day. The amount of water in the leaf may determine to a certain extent the damage by the oil. It seemed to him, therefore, that another thing that must be done before we can really properly understand the action of the oil will be to study the effect of the oil upon the vegetable tissue. Perhaps this had already been done, but it was still in large part a mystery to him.

Mr. Webster said he had used oil from two wells located in different parts of Ohio this year, and although the analysis ran almost exactly the same in each case the effect has been different. In the one case he had not seen the orchard for several weeks, but when he last saw it the peach trees seemed to have been in many instances killed by the use of crude petroleum. He could not say whether the oil had been applied just before or just after a rain. In the other case the trees sprayed were seedling apples on the experiment farm, the experiment being made to determine if possible the effect upon the trees and not against insects. Some of the trees leaved out at the proper time about as freely as usual, while others had no leaves at all. At the present time, however, there was no apparent difference whatever in them, all having finally leaved out precisely the same. It was evidently nothing but a temporary injury. His experiments had produced such varied results that he was badly mixed up and did not favor

recommending the use of kerosene of any sort. He was of the opinion that the variation would be just as great in the crude article as in the refined.

Mr. Hopkins said that in West Virginia they have a great variety of petroleum, from that as thick and black as molasses to the thin light-colored product. The oil obtained from the Standard Oil Company is a mixture of all kinds except the heavy oil. The heavy oil is used for lubricating machinery. He had obtained some results which are quite at variance with the testimony of others and shows what conflicting results can be obtained in different States. In one case he recommended crude petroleum as an experiment in a large orchard which was almost dead from the scale and which the owner refused to cut down. It had been sprayed once with pure kerosene, which did some damage and killed many scales, but the owner had allowed it to go without treatment and the scales had again covered the trees. He sprayed it with crude petroleum obtained in Baltimore. When he last saw the orchard, in April, the trees were black and greasy, but underneath the bark they were as healthy as ever, the leaves were coming out in full, and the owner claimed that the crude petroleum had benefited them. He was not recommending the oil, but simply giving this as an example. His spraying was done in February and wherever the oil touched the bark it remained dark and greasy for months afterwards. A thorough examination failed to reveal any of the living scales, and he believed that the young scales could not settle and live on the oily surface. He felt very much encouraged. It is one of those problems which require cooperative work. As a result of further investigation, he thinks it may become one of the best insecticides ever discovered. He could not think of any better work than trying to find the reasons for the great difference in results in experimental work with insecticides.

Mr. Webster said he was unable to see what could be gained even if crude petroleum should be perfected. It was true that we will have to get something cheaper and more effective than whale-oil soap, which if used on peach trees except during the winter will destroy the fruit, but in view of the difficulty he had had in getting crude petroleum and the high price asked for it, how much better an insecticide than whale-oil soap would we have even if it was perfected? He thought that entomologists who cared for their reputation would experiment much and say little for publication, for the present at least. He further stated that while experimentation was always in order, it would be best to stick to the whale-oil soap until more obscurities in regard to the use of petroleum had been eliminated.

Mr. Johnson said he agreed with Mr. Webster. We have got to get something better than kerosene for both peach and plum. In one instance he had sprayed an orchard of two hundred 9-year old peach

trees in February with 25 per cent kerosene and not a tree was living on the 28th of April last. He was at present making midsummer experiments. It seemed to him that atmospheric conditions were at the bottom of the difficulty and he thought it would be necessary to go back to the old whale-oil-soap remedy which destroyed the scale more effectively and was less liable to injure the trees. It would not be wise to substitute crude petroleum for whale-oil soap. After three years experience with kerosene, whale-oil soap, and gas he was of the opinion that there are other conditions which must be studied more seriously in the future than in the past, and he heartily agreed in the opinion of the chairman that cooperation is desirable. He believed it would produce better results in the future. We must not confine our labors to the territorial boundaries of a State but go outside for information, suggestions, and the experience of others.

Mr. Fletcher stated that he was glad to hear what had been said about whale-oil soap and crude petroleum. He had never yet been able to see what object there was in trying to use petroleum. The results were too conflicting and always unsatisfactory, and the question of cost in the destruction of the apparatus was never considered. There was very slight injury to the hose in the use of potash whale-oil soaps, which could now be obtained of pretty uniform manufacture, and had been giving good results. These are always to be had and easy to get to most places. You can be sure of getting your whale-oil soap within a week or ten days, while he had found there was considerable difficulty in getting crude petroleum. He was of the opinion that there is room for experiment with much weaker mixtures of the potash soaps during the summer. His experience had been in favor of the potash soaps in preference to the crude petroleum or kerosene mixed with water. Even with the old kerosene emulsion there is sometimes unexpected injury to trees, which was always put down to difference in the oil or in the water. He was satisfied for the present that the whale-oil soap was the safest remedy; at any rate, it is the safest for those who are official entomologists, and have to recommend formulæ to people who will make a mistake if they possibly can.

Mr. Sanderson stated that he had not had much experience with crude petroleum, but so far his experience has been favorable. He sprayed an orchard of one hundred trees on the Delaware River with crude petroleum in the latter part of January, on a cloudy day, with a little hail and rain soon afterwards. The trees were mainly Bartlett, Kieffer, and Manning pears, which had been sprayed the year before with pure kerosene and somewhat injured, but which had recovered. Two months later, in March, he sprayed another lot of one hundred trees with 25 per cent solution of crude petroleum. It was a very windy day, and almost all the trees previously sprayed got a dose of the 25 per cent solution on one side. Examination shows no injury on either lot.

Here and there could be seen a tree not doing well, but that was owing to the spray of a year before with pure kerosene. The buds were not injured. The growers in his region never use whale-oil soap, because it destroys the buds. They have used it during midwinter and destroyed buds, and have now given it up.

Mr. Woodworth said that he did not wish his former remarks to be construed to mean that there is no future for crude petroleum as an insecticide, but he desired to emphasize the fact that there is a great deal to learn. In some of the large orchards in California crude petroleum has been used with success, but not against the San Jose scale. He is of the opinion that there is a great future for crude petroleum, and that the time will come when it will be cheaper in the East. In California it is the cheapest insecticide that can be bought.

Mr. Hopkins said that in his State (West Virginia) crude petroleum was sold to the Standard Oil Company for about 3 cents per gallon, or $1.25 to $1.50 per barrel, and if there was sufficient demand for it for a specific purpose he thought there was no question but that the cost would be reduced much below that of whale-oil soap.

The chairman appointed the following committees:

Committee on nomination of officers for ensuing year: Messrs. Fletcher, Howard, and Woodworth. Committee on resolutions: Messrs. Felt, Johnson, and Burgess.

The morning session then adjourned; the afternoon session to begin at 2.30 p. m.

AFTERNOON SESSION, JUNE 21, 1900.

On motion of Mr. Webster all discussions were limited to five minutes each, no person to speak more than twice on the same subject.

Mr. Webster moved that the secretary place on the list of foreign members the names of

Gustavo Leonardi, of Portici, Italy.

Robert Newstead, of Chester, England.

Karl Sajo, of Budapest, Hungary.

Mr. Howard proposed the name of Edmond Bordage, of St. Denis, Réunion.

In discussing the annual address delivered by Vice-President Gillette, Mr. Weed said he thought, as did all the other members, that there were very many excellent ideas in the address. One of the most important ones was that about active cooperative work and the sending of parasites back and forth. If close track was kept of some of the great crop pests in this respect, watching carefully the parasitism, entomologists in different States could do each other a great deal of good.

Mr. Webster thought there were a great many good features in the address and very many of vital importance to station entomologists.

It seemed to him that the fact that this international and interstate matter was made a prominent feature was a very good indication of progress, something that was hardly anticipated when the Association was established. There were so many good points in the address that it was absolutely impossible to do justice to it in a few minutes. Some things, however, he considered entitled to especial emphasis, and one was the matter of duplication of work. The fact that one member was working upon a given species in one State and another member working upon exactly the same species in another State, while apparently a duplication of work, is not, in fact, a duplication at all, because in all probability very different results would be obtained. No two men see the same thing in the same light, and climate, latitude, and elevation also have a great deal to do with the actions of insects. As to the matter of mapping out work, it must be remembered that most entomologists are limited in their powers, and, while they can plan work, it is not always easy to carry it out, as a station director or a board of trustees might greatly revise his plans. In regard to the introduction of foreign parasites, it seemed to him that it is a field we are just entering, with the future all before us, and there would be many failures; but where such work was carried out carefully he believed it might prove successful with respect to a great many introduced species of insects. When we come to carry it out between States, however, other difficulties will surround us. He went to a great deal of pains to obtain from Professor Morgan an egg parasite of Murgantia, and after getting it established it was swept out of existence during the winter of 1898–99, and no good has come from the introduction. He was also of the opinion that a great deal could be done by an exchange of experiences with insecticides, such as had taken place in the morning session, as insecticides seldom have the same effect in different portions of the country. It had always seemed to him that the work of the economic entomologist was very largely to work out life histories, and after he had done this and had found out methods that could be used to destroy the insect his duty ends and the work of the horticulturist and the agriculturist begins. He did not think it ought to be necessary for an entomologist to make of himself a mechanical, hydraulic, or civil engineer.

Mr. Fernald referred to the remark just made by Mr. Webster to the effect that no two men saw the same thing in the same light, and said that the same was often true in listening to an address, for generally no two men got the same ideas from it. For him other parts of the address than those mentioned by other speakers had presented themselves with particular force, and especially those with reference to collections in connection with the insectary or entomological work of any kind. It seemed to him that the work of a station, whether connected with a college or not, is most emphatically educational, for

even if it be not educational to students or visitors, it is certainly educational to the workers at the station themselves, and by continually adding to such a collection they are adding to their education as well as to the education of the residents of the region. He had thus far found a great demand for collections rather different from those ordinarily met with. The ordinary collection contains the rare insects as frequently as it does the destructive ones, and by that he meant to uphold the question that was raised in the address with reference to how many of the common insects could be found in different collections. He suggested, that so far as his own experience goes, there are too few collections in which all stages are preserved in connection with the work that insects do. A large part of the material that he receives in Massachusetts does not contain any insect whatever, but simply a sample of the work of the insect which has either escaped from the box or was never inclosed. The problem in such cases is to tell what has done the damage by the damage itself. He found that his greatest help was to preserve specimens of the insect and of the work it was doing, and he used such specimens in the identification of material sent in perhaps fifty times as often as any other specimens. Our collections, in his opinion, should be amplified along the lines of early stages and the work done by the insects, and such collections will appeal strongly to the people. The whole address was interesting and suggestive, but it was this feature which interested him most. He had also had experience with the Murgantia parasite obtained from Louisiana by the kindness of Mr. Morgan, and while he was now fortunate in not having Murgantia to deal with, it was a great relief while searching around to find that there was some one who could assist him, and he thought anything in that line should be encouraged, for when a man wants a thing of that sort he wants it badly.

Mr. Johnson said there was another important suggestion implied in the address, and that was the commercial side of entomology—if the term might be permitted. We have enough systematic entomologists at the present time, and perhaps enough economic entomologists, but we do need another lot of men who will take up purely the œcological side; that is, they must study conditions in the field. The day is coming, and is not far distant, when our great commercial railroads and some of our greatest manufacturing concerns, such as canneries, will employ œcological entomologists just as they employ engineers and other skilled labor. He felt quite certain that this would come about, and that a new field would open to young men especially who would take up this commercial side of the entomological problem. To give an illustration of what he meant, he said he would try to bring this out in a paper which he would read on the following day on the subject of the pea louse in Maryland, which has destroyed more than $4,000,000 worth of green peas along the Atlantic coast this season.

When insect injury touches the pockets of the producers to that extent they are going to look around for the men who are looking after the bugs. It means money to them. He had been in consultation with some of the high officials of one of our principal railroads, and felt certain that the day is not far distant when these roads will employ men to take up the entomological study and development of the territory through which their lines run. He considered this an important point for the student of entomology to bear in mind in the future. Of course such a man must go out and study conditions over a vast area. He must also know what our worthy chairman is doing in Colorado; what Mr. Weed is doing in New Hampshire; what Mr. Lounsbury is doing in South Africa; what Mr. Fletcher is doing in Canada—in short, he must keep posted on the entomology of the whole world and be ready to meet any emergency.

Mr. Hopkins said that along this same line he might mention the fact that he found in the spruce forests of Maine that a large timber concern controlling some 300,000 acres employed a practical forester and scientific man, and paid him about $1,500 a year, to give advice on practical methods of cutting timber and making surveys. The concern mentioned sent this man with Mr. Hopkins through the spruce forests of Maine to learn all he could about forest insects. This was another evidence of the fact that the practical men are beginning to realize that they can very profitably utilize the results of scientific research.

Mr. Kirkland said that if the members of the Association knew the circumstances under which the presidential address was prepared they would appreciate it all the more. Mr. Bruner decided at a rather late date that he would be unable to be present, and Mr. Gillette very kindly consented, on short notice, to write an address. It was a matter of congratulation to the members of the Association that they have in their membership one who was both willing and able to do so good a piece of work at such short notice.

Two papers were presented by Mr. Weed, as follows:

ON THE OVIPOSITION OF AN EGG PARASITE OF VANESSA ANTIOPA.

By Clarence M. Weed, *Durham, N. H.*

[Abstract.]

One May morning at Durham, N. H., a *Vanessa antiopa* was seen ovipositing on Salix. After laying about twenty eggs she flew away. The moment she left, a small hymenopteron—since identified by Dr. L. O. Howard as *Telenomus graptæ* Howard—was seen running over

the eggs. The parasite was watched for the next half hour, during which time it oviposited in fifteen eggs. Does the parasite ride around on the butterfly, waiting for oviposition?

ON THE OVIPOSITION OF CACŒCIA CERASIVORANA.

By CLARENCE M. WEED, *Durham, N. H.*

[Abstract.]

The eggs are laid in flattened masses on the bark of chokecherry shrubs very near the ground. The egg mass at first is yellow, but later it becomes brownish, so that it is very difficult to distinguish it from the bark. There is but one brood of larvæ a year, the eggs laid in summer remaining unhatched until the following spring, then the young larvæ crawl to the top of the shrub, where they begin the construction of the tent.

The next paper was entitled:

THE RELATIONS OF PIMPLA CONQUISITOR TO CLISIOCAMPA AMERICANA.

By CLARENCE M. WEED and WILLIAM F. FISKE.

[Abstract.]

Pimpla conquisitor is the most important hymenopterous parasite attacking the pupa of *Clisiocampa americana*. The eggs are commonly laid in the cocoon of the host soon after its construction, and several experiments conducted with a view of ascertaining the invariability of this rule go to show that exceptions are at least rare. The development of the parasite from the egg takes but little more time than that required for the completion of the metamorphosis of Clisiocampa after constructing its cocoon, so that their respective dates of emergence are not far apart. The pupa shell of the host is completely filled by the larva of its parasite when the latter is full grown, but after the discharge of the semisolid meconium it is scarcely half as large as before.

The larvæ of Pimpla are attacked when nearly or quite full grown by a secondary parasite, *Theronia fulvescens*, the larvæ of which feed externally upon their host and finally replace it. The various stages of this species from the first have been observed and many specimens reared. It is about two weeks in reaching maturity from the egg. A peculiar fact noticed in the observations upon this species is that in the first stage from the egg the minute larva has a hard chitinous head with large jaws, a feature totally lost in the succeeding molts.

Another interesting point in connection with the life history of *Pimpla conquisitor* is the fact that it occurs both as a primary and a secondary parasite on the same host, *Clisiocampa americana*. Very small individuals were bred from several species of primary parasites attacking the immature caterpillars, the species most commonly acting as host in this manner being *Limneria fugitiva*.

The next paper, by Mr. Fernald, was entitled:

ON THE MARGUERITE FLY.

By H. T. FERNALD, *Amherst, Mass.*

[Withdrawn for publication elsewhere.]

Replying to a question from Mr. Johnson, as to whether hydrocyanic-acid gas had been used, Mr. Fernald stated that there was objection to the use of this substance among florists, who have an exaggerated idea of the danger involved and will not often use it. He had no doubt hydrocyanic-acid gas would be more effective, but thought the florists would prefer to use carbon bisulphide, as this substance had proved satisfactory.

Mr. Fletcher thought that remedial work against the flies during the winter would be better than work against the larvæ after they have eaten the leaves.

Mr. Fernald replied that the problem had been thus far looked at by him entirely from the florists' standpoint, and the insect treated in the stage at which the florists would first see it and want to treat it. He was certain, however, that the fly could be handled by fumigating the greenhouses.

Mr. Woodworth said that the fear that exists in the East over the use of hydrocyanic-acid gas was looked upon by many Californians as very funny. In his State the greenhouse man will pick up his material in his hands, charge his vessel, walk out deliberately, and close the door after him.

Mr. Johnson stated that one could not be too careful in the use of hydrocyanic-acid gas, and he wanted to caution all those who used it. In one instance, after preparing the chemicals necessary for generating the gas, he thought he would take his chances in dropping the cyanide in the jar and get out, but he felt the effects of the gas almost immediately. By the time he reached the door a haze came over his eyes, everything looked black, and a feeling similar to blind staggers overcame him. Experience has proved that it is not a trifling matter, and he would caution all who had occasion to use the gas. At the same time he felt that hydrocyanic-acid gas was the coming material for the destruction of certain insect pests in mills where stored grain and

other products become infested. He had recently performed one of the largest experiments ever undertaken in the use of hydrocyanic-acid gas, in a five-story brick mill in Canada. Over 150 pounds of potassium cyanide was discharged in the mill, and the results were very gratifying. It practically eliminated the flour moth from the mill.

Mr. Fletcher said he did not think enough care could be taken in giving instructions when recommending hydrocyanic-acid gas for general use, especially in this stage of introducing it, as a fatal case or two would put an end to its use entirely. Several striking instances had lately been mentioned which show the intensely poisonous nature of this gas. Much more care, instead of less, than has been exercised in the past is necessary. With regard to the use of bisulphide of carbon, he certainly was not satisfied with its use in mills, and had not got the results promised for it. He was very sorry Mr. Marlatt was not present at the meeting, as his laisser-faire policy had given him a lot of trouble with the people he had to deal with, and he was of the opinion that some others of the Association might have liked to discuss that matter somewhat.

Mr. Sanderson suggested the use, in cases where only a small amount of the gas is required, of gelatine capsules, which require about one minute to be eaten through by the acid, thus giving time to get the box closed.

Mr. Webster stated that his fumigating houses in Ohio are covered carefully and made perfectly air-tight by the use of layers of building paper, but if the ordinary nurseryman makes his own fumigating house he would not make it any more air-tight than a hencoop. He had tried almost every way of introducing the cyanide, but the man who did the work invariably complained of severe headache, until he devised a method of combining the mixtures under the floors.

Mr. Lounsbury suggested that a simple way was to have a small lead tube leading from the outside of the house, the vessel containing the cyanide being placed under the tube, the door closed and locked, and the water and acid freshly mixed being poured in through the little funnel or tube and the aperture closed.

The next paper was entitled:

OBSERVATIONS ON DIABROTICA 12-PUNCTATA OLIV.

By A. L. Quaintance, *Experiment, Ga.*

In the Southern States particularly this insect is a corn pest of considerable importance. Injury to the corn plant is confined almost entirely to the work of the larvæ on the underground portions of the plant, as the roots and stem below the soil. Injury results to corn

most manifestly, if not mainly, during the spring of the year, while the plants are quite young; and it is a common observation of farmers, throughout Georgia at least, that the plants on low, wet soils are much more seriously damaged than corn planted on uplands. The extent and nature of the injury may vary, but the most usual symptom of the work of the larvæ is in the wilting and falling over of the central leaves, or "bud," of the plant, and later becoming brown and dry. Plants showing this appearance when examined are almost invariably found to have been bored into at the base of the stem in such a way that the central and vital part of the plant has been more or less cut free from the tissue below. This wilting and dying of the central roll of leaves of the corn plant has doubtless suggested the term "bud worm," by which name the larvæ seem to be very generally designated. Other terms, as "bill bug" and "wire worm," are less frequently used in speaking of this insect. The recognized English name, the Southern corn root-worm, as used by entomologists, I have never heard used by planters.

Not all plants showing the wilted "bud" have necessarily been injured by the Southern corn root-worm, as in frequent cases wire-worms have been found to be the cause of the trouble. Less usually the white ant, probably *Termes flavipes*, has been found to have eaten into the stem near the surface of the ground, chewing out relatively large cavities. Injury from white ants has been most common in fields planted to cotton the previous year, and the decaying stalks on the ground have in most cases been close to or in contact with the infested corn plant.

Prof. F. M. Webster was probably the first to indicate the injurious character of these larvæ on corn, in the Report of the Secretary of Agriculture for 1887 (p. 148). Mr. Webster's observations were made in Louisiana, and while from the article referred to it is not apparent whether the larvæ observed were actually bred into the adult condition or not, there can be no reasonable doubt from his description of the larvæ and their injury but that these were larvæ of *Diabrotica 12-punctata*.

There is good reason to believe, however, that this insect has been injurious to corn, in Georgia at least, many years before we find any reference to it in the literature of economic entomology. Several different Georgia farmers, who are quite familiar with the larvæ and their work, affirm that they have known the "bud worm" ever since they can remember, which in some instances could reasonably be expected to extend back over a period of at least fifty years.

The years 1889 and 1890 witnessed a rather general outbreak of this insect, and the injury to corn attracted attention over quite a large area of country, including Illinois, Indiana, Ohio, and most of the Southern States. This outbreak was the occasion of a careful

study of the pest, and from 1890 to 1893 several important contributions were made to our knowledge of the insect, notably by Prof. H. Garman, Dr. S. A. Forbes, and Dr. C. V. Riley. The economic bibliography of *Diabrotica 12-punctata* includes some thirty references, though many of these are brief notes relative to the food habits of the adults.

During the present spring the insect has been quite abundant in Georgia, and it has been the object of considerable complaint, not only on account of injury to corn by the larvæ, but on account of injury to the foliage of various plants by the adults.

The first beetle observed by the writer was on March 12, when a gravid female was found in a road extending between two fields of fall-sown oats. March 13, twenty minutes' sweeping of a rye field gave two dozen beetles, all gravid females. Some of these deposited numerous eggs in the vials by the next morning. On March 22 but few beetles were to be found, owing to the cool weather, but on March 28 they were exceedingly abundant, feeding on rye, oats, and alfalfa. Something like seventy-five were captured in a few minutes' sweeping of alfalfa. The females captured were almost all heavy with eggs, these showing plainly through the abdomen as apparently fully developed. Subsequent occasional sweepings of alfalfa and rye indicated that the beetles were most abundant about April 10, after which date there was a very pronounced decrease in the number captured, and many of the beetles captured had evidently oviposited.

Most corn planted on the station had made its appearance above the soil by April 14, and careful examination was made almost daily to detect the beetles in the act of ovipositing. No beetles, however, were observed in the cornfields until the 19th, when three were captured, one gravid, the other two having evidently oviposited. By the 24th, beetles were much more abundant in cornfields, and were no doubt ovipositing, though I could never detect them in the act. An hour's search with a "bull's-eye" lantern on each of two different nights, in fields where beetles had been somewhat numerous during the preceding afternoons, failed to find the beetles ovipositing. They were apparently, on the other hand, not active, many of them in more or less secluded situations. Beetles were observed to be more numerous on the higher parts of cornfields than on the bottoms, which is the opposite of what would be expected, since the larvæ are undoubtedly more numerous in wet bottom soils than elsewhere. It is a prevalent opinion among farmers in Georgia that eggs are deposited during the cool nights of April, and it may be that eggs are deposited mainly at night. Early morning search for beetles has never revealed them active, but in secluded situations, as within the young leaves of a corn plant or under trash on the ground, and they have not been observed to be active until warmed up by the morning's sun. While

in the cornfields the beetles do not feed on the young corn plants to any extent, but on seedling weeds. They have been observed repeatedly to leave corn plants and crawl here and there on the ground until finding a seedling weed, when it would be eaten down close to the ground.

The first signs of injury to corn were observed May 2, when numerous wilted buds were discovered in a low plat of corn on a low situation on the farm. Larvæ found at this date were most of them about one-third grown; two were found, however, almost, if not quite, full grown. The two weeks of hot and dry weather following this date caused a general wilting of plants badly injured in the crown, and frequent examinations of the roots of infested plants were made. It soon became apparent that a rather small proportion of the larvæ among the roots of plants attacked the crown, causing the death of the plant; but that, probably in the majority of cases, the larvæ fed on the roots or on the outside and under the stem at the origin of the roots. Rarely were the roots channeled out longitudinally, but more usually eaten into or eaten quite off. On the side of and below the stem of a corn plant in four or five leaves channels or grooves may be eaten, the larvæ not attempting to bore into the heart. Where such is the mode of attack, the outer leaves are likely to appear more or less yellow or rusty in blotches, or even yellow and dry. When the roots only are attacked but little injury seems to result to the corn; in fact, many of the most thrifty plants pulled up and examined had as many as five and six full-grown larvæ among the roots. In a word, larvæ were found quite generally among the roots of most plants on low soils, as many as three to six to each hill, and in a relatively small proportion of cases were plants attacked at the crown, causing the usual wilting of the bud.

The first pupa found in the field was May 8. On May 10 a rather extended search proved them to be quite numerous. The first beetle of the new brood was observed May 12, from which date they have become increasingly abundant. At this writing, June 12, beetles are quite abundant, feeding mainly on the blossoms of various cucurbits.

The last stragglers of the over-wintered brood had disappeared by the last week in May. The broods are thus seen to overlap somewhat, but it is likely that these stragglers passed the winter as larvæ or pupæ, completing their development in the spring.

Beetles have been observed feeding on the foliage of the following plants: rye, oats, alfalfa, corn, crimson clover, currants, gooseberry, and such garden vegetables as beans, beets, squash, cantaloupes, watermelon, cabbage, Irish potatoes, turnips, tomatoes, and on the flowers of apple, pear, quince, plum, peach, and cherry. In fact, the beetles seem to be practically omnivorous. Larvæ have been found on the roots of corn, rye, *Bromus uniloides*, and garden beans. On this latter crop considerable injury was done, larvæ boring into the stem and

eating out channels up the stalk, frequently up to the seed leaves. The beetles were very injurious to apple bloom, and doubtless aided much in the general distribution of pear blight that has occurred in Georgia this year.

LABORATORY OBSERVATIONS.

Egg laying was repeatedly observed in the breeding cages. In ovipositing the stylus-like ovipositor is pushed down into the soil to a depth of from one-eighth to one-fourth of an inch, where it is held until the egg is forced down the extensible oviduct and out at the opening at the base of the ovipositor. This requires usually but a few seconds, and after moving a short distance another egg may be deposited. The writer has observed a beetle thus deposit fifteen eggs in quick succession. Occasionally the ground is found too hard for penetration, when another trial is made. Ordinarily but one egg seems to be deposited in one place, but occasionally two to four may be found together. In close quarters, as in a vial, or even under a medium-sized lamp chimney, twenty to thirty eggs have been found together in a mass. An individual gravid beetle confined by itself usually deposits the majority, if not all, of its eggs in a few hours, and my observations as a whole incline me to believe that a beetle normally will deposit its eggs in the course of one or two days.

Many dissections of gravid beetles show that the number of eggs may vary from 62 to 87, with an average of about 75.

Eggs secured March 14 hatched April 14; eggs secured March 29 hatched April 20, and eggs secured April 24 hatched May 16. The variation is doubtless due to the difference in temperature. Just-hatched larvæ are quite agile and make their way readily through the soil. Larvæ placed on the roots of corn plant in one end of a root cage, after the destruction of the corn, made their way through the soil to a plant in the other end of the cage, 10 inches distant. Larvæ may also descend some 8 or 10 inches below the soil, searching for food, as was witnessed at different times in the root cages.

The larvæ hatched from eggs, previously mentioned, on April 14, pupated May 12, spending five to seven days in the earthen cell before pupating. The adults appeared May 21, the life cycle in this case extending over a period of about nine weeks.

In another batch bred through eggs secured April 25, hatched May 3, the larvæ pupating May 27, adults appeared June 5, thus extending over a period of forty-one days, or about six weeks.

EXPERIMENTS WITH MEANS OF CONTROL.

Two areas were chosen of about one-half acre each, on low and moist soil, on which to test the effect of different methods of planting and the effect of the use of different insecticidal substances. Each area was divided into 27 plats, and treatment for the two areas, plat

for plat, was the same, thus duplicating the work on two different situations on the farm. Without going into detail, I will mention some of the ways which the plats received treatment. Corn was planted deep, shallow, early, late, with an excess of seed in the hills, and drilled. In one plat the earth was listed over the corn just as it was coming through the soil. In another plat the earth was thrown away from the corn as much as possible, thus exposing the lower part of the stalk somewhat. Plats were planted with seed corn soaked in strong kerosene emulsion, in diluted kerosene emulsion, and in chloride of lime. Other seed were coated with tar and with sulphur made adhesive by moistening with molasses. One plat was treated with kainit, at the rate of 2,000 pounds per acre, just as the corn was coming through. Another plat was sprayed with kerosene emulsion around the hills as corn appeared above ground. In still another plat a handful of tobacco dust was placed in each hill at the time of planting seed.

By May 12 the corn was mostly 10 to 12 inches high and the majority of larvæ were from two-thirds to full grown. At this date sixteen hills from each plat were carefully dug up, the larvæ counted, and the nature and extent of the injury noted. In this work it soon became apparent that the various methods of treatment, except late planting, and the different insecticides employed appeared to have no appreciable effect in reducing the number of larvæ as compared with the untreated checks. Injury resulted to seed corn soaked in strong kerosene emulsion for six hours, about 60 per cent failing to germinate. Curiously enough, the plats receiving kainit at the rate of 2,000 pounds per acre gave a larger per cent of larvæ than any of the others. This may have been due to the moister condition of the soil, following the use of this fertilizer.

Corn planted May 4 was but little injured, by this date, the beetles mostly having deposited their eggs.

In the case of plats, where an excess of seed (8 to 10) was dropped in each hill, in no case were all of the plants in a hill destroyed, sufficient plants being left for a good stand, and in most hills thining out was necessary. In plats where the corn was drilled the injury was relatively small. From this season's work it appears to the writer that if bottom lands are planted to corn late, as the first of May, or, if eight to ten grains be dropped in each hill, injury from the Southern corn-root worm may be practically avoided or so distributed that the damage will be inconsequential.

In discussing this paper Mr. Webster said that last fall he had stepped off a portion of a strawberry bed badly infested with white grub and applied kainit at the rate of 4,600 pounds to the acre, but when he came to count the grubs he found more in the portion upon which he

had applied the kainit. He could not see any reason for considering kainit an insecticide. He had tried it for white grubs, strawberry root borers, rose beetles, and wireworms and could not see that it had any effect upon any of them. If it killed one single individual he was not able to see it.

Mr. Lounsbury said he thought there was a great deal to be said against kainit and a good deal to be said in its favor. Perhaps weather conditions immediately following the application may have something to do with its efficacy. For instance, a rainfall might add to its insecticidal value.

Mr. Webster stated that he had taken particular pains to apply water to carry the kainit down, but without effect.

Mr. Lounsbury presented the following paper:

NOTES ON SOME SOUTH AFRICAN TICKS.

By C. P. Lounsbury, *Cape Town, South Africa.*

The purpose of these notes is to present briefly the more important of a number of observations made in recent studies on the habits and associations of several species of South African ticks. The notes are made from memory, and, lest errors should creep in, detailed particulars are not attempted. The primary object of the studies was strictly economic, it being to obtain data that would assist in determining the courses best adapted for the suppression of the ticks. Some of the species have long been a deterrent to stock farming in certain parts of the Cape Colony, and of late years have increased to an extent that threatens the progress of the cattle industries in several districts. There had been, moreover, a suspicion of long standing in the country that one, at least, of the species was in some way associated with a generally fatal sheep and goat disease known as "heartwater." This disease during the last half century has gradually become extended over a tract of country in the southeast of the colony which was once capable of supporting several millions of sheep. The fowl tick considered is a poultry pest common to many warm-temperate and subtropical lands. It is the *Argas americanus* of the Southern United States.

THE BONT TICK.

The tick of greatest importance, because of its injuries to stock, is *Amblyomma hebræum* Koch, commonly known as the bont tick. "Bont" is a Dutch word, equivalent to "variegated," and its application in this case has reference to the mixed coloring on the back of the male. The bont tick is supposed to have spread into Cape Colony from the eastward between sixty and seventy-five years ago, and it is still restricted to southeastern districts—the same districts in which the heartwater disease occurs. It is the largest of South African

ticks, and perhaps is of unrivaled dimensions. The American cattle tick is a mere pigmy in comparison. The bont female measures up to an inch in length, three-fourths of an inch in width, and half an inch in thickness. After engorgement she drops from her host and secretes herself. In soft sand she may burrow an inch or two downward, while in harder soil or in rubbish she may rest content after burying the forepart of her body. She lays her eggs in a compact mass anterior to herself in this retreat and dies at her post after the completion of the task. Exceptionally large females probably deposit as many as 20,000 eggs; a careful estimate on one batch of eggs obtained in confinement placed the total number at about 17,500. Oviposition, incubation, and all the other periods in the life cycle off of the host vary in duration with the temperature of the surroundings. Development in these stages proceeds all through the year, but is many times more rapid in summer than in winter. The winter season in the area infested is mild and dry, without snow and with but few hard frosts. The young ticks ascend the grass, bushes, or other support above them and there patiently await a host. The passage of animals in their vicinity, by means not yet satisfactorily determined, arouses their attention and incites them to run about clawing the air with their forelegs. Attachment to a passing object is secured by the waving legs, but a large proportion of the tiny creatures are brushed off again almost immediately. Such unfortunates must, perforce, await other opportunities. If the passing object prove a host those that contrive to maintain their hold soon find the skin and inserting their rostra proceed to gorge themselves on the blood. The operation of engorgement ordinarily requires about six days. Except as regards the duration of the different periods, the habits of the bont tick from the dropping of the female to the engorgement of the larva coincide with those of the American cattle tick; thereafter, however, there are differences. The bont larva when replete with blood withdraws its rostrum, drops from the animal and undergoes its metamorphosis in hiding on the ground. Sixteen days or longer, according to the temperature, pass before the larval skin ruptures and the eight-legged, flat-bodied nymph appears. The nymph seeks a host not alone through patient waiting and waving of its claw-armed forelegs but by running about on the ground when an animal is near. Engorgement is again completed about the sixth day and the tick then bears a superficial resemblance to the gorged female of the common cattle tick; it is, however, shorter and relatively broader and of a different shade of blue. Voluntary dropping and, after an interval of eighteen days or longer, a second molting follows. The tick has then reached the adult stage. The sexes, which were indistinguishable in the earlier stages, may be told at a glance when adult. They have similar dimensions, but the markings and colors are dissimilar, and the shield of the male,

as is characteristic of the Ixodidæ, covers the entire dorsum, while that of the female is restricted to a small area above the rostrum. The adult bont tick is seldom found on bushes or grass, and it appears that it seeks a host solely from the ground. The male takes up a position independent of the female, and after several days, generally four or five, he makes known by straightening his body and waving his legs when one of the opposite sex approaches him that he is prepared for a mate. The female, without having previously fed, searches about until an eligible male is found, and on finding one embraces him and installs herself on the skin with her ventrum opposed to his. When an unpaired eligible male is wanting the female may attach herself by a mated couple, but she rarely settles down distant from one of the other sex, and her evident object in settling by a couple is to secure the male after the other female leaves. In about eight days from affixing herself to a host, or longer if a mate is not at once secured, the female becomes fully distended with blood and drops. The male becomes somewhat thicker in body but no longer or wider, and appears to subsist not on blood but on products of suppuration in the wound he makes. He may remain for many months in the one position and mate successively with a number of females. One specimen under observation has been attached over seven months. The two sexes are produced in approximately even numbers, but the males appear to predominate, owing to their longer attachment.

How copulation is effected has not been determined with certainty. It is conjectured that the female protrudes an organ by invagination, which is brought into intimate contact with the sexual orifice of the male. Mr. Claude Fuller, the Natal entomologist, called my attention to the probability of this unique means for intercourse with respect to another Ioxdid, and since I have repeatedly witnessed the quick retraction of a protruded organ by the female of the bont and several other Ixodidæ when separating couples. The invagination may be similar to that which occurs in the process of oviposition. The male orifice in the bont and some other species is beneath a rounded, lid-like shield which opens forward, and when males have been suddenly parted from their mates this shield has ofttimes been observed to be raised. Females do not appear able to complete their engorgement until they have mated.

The bont tick infests cattle, horses, sheep, goats, and ostriches, and probably various other animals, as on the evidence of farmers it is not infrequent on old or weakened buffaloes and other kinds of horned game. It attaches itself to man occasionally, and now and again is found on the barnyard fowl. Curiously, mules seem to become less infested than horses. That it may mature and reproduce when reared on horses, cattle, and goats has been established, and that it may fully engorge itself, both as a larva and nymph, on ostriches and afterwards

successfully molt has also been affirmed. The adults are rarely found on the back or high on the flanks of the animals. They get most numerous on the relatively hairless parts under the shoulders, between the thighs, about the genitalia and anus, and on the udder. The larvæ and nymphs prefer the same situations, but a few also get on to the back and flanks; of all parts they appear to prefer the feet. The adults are considered responsible for the formation and spread of sores. Such sores on calves may involve and destroy the teats. So serious is this evil that on some farms a milch cow with a sound udder is exceptional.

All stages of the bont tick may fast many months while awaiting a host. Larvæ have remained alive fully seven months in a cork-stoppered bottle, and a single adult an equally long time. Females forcibly detached from a host without injuring the rostrum may survive and lay fertile eggs, even if only half engorged. Males thus detached rapidly lose vitality and generally succumb within three days, but while they have life they lose no opportunity to again attach themselves, and do not hesitate to then attack even the hand of a man. The method of piercing the skin may be easily followed in the case of such specimens.

By a carefully conducted experiment the bont tick has been found by the writer to transmit the heart-water disease alluded to in the opening paragraph. Larvæ were reared on diseased goats. As nymphs these ticks were placed on healthy goats and the disease produced. In one instance ten ticks transmitted the infection. An account of the experiment is given in the Cape Agricultural Journal for May 24, 1900. It appears probable that the bont tick may also communicate "redwater," the disease known in America as Texas fever. A cow purposely infested with a few specimens which came from a redwater area contracted the disease when no other possible source of infection appeared present. The circumstances surrounding the incident are given in the writer's annual report for 1899 (Report of Entomologist, Department of Agriculture, Cape of Good Hope).

THE BONT LEG TICK.

The second largest common South African tick is *Hyalomma ægyptius* Audouin. The Dutch colonists know it as "Bontepooten," a term suggested by bands of white on the legs of the adults, and from this term is taken the English colonists' name here adopted. This species is found all over Cape Colony, but is best known in the dry, inland districts. It occurs in other parts of Africa and elsewhere. The fully engorged female sometimes measures four-fifths of an inch in length and over a half inch in width. The life cycle has not been traced, but scattered observations indicate that the molting and host-securing habits are similar to those of *Amblyomma hebræum*. The

hosts, too, are the same. It is more frequently a subject for complaint with sheep, goat, and ostrich farmers than with cattle farmers, but perhaps this is because it chances to be naturally more abundant in the districts where the kinds of stock first mentioned are farmed. It infests much the same situations on the hosts as the bont tick, and is a frequent cause of lameness, particularly in sheep and goats. Males predominate on a beast and remain a long time. The various periods of the life cycle, so far as these are known, are all of shorter duration than the corresponding periods with the bont. There is presumed to be, ordinarily, one full generation in the course of a year. This species, as an adult, appears to far oftener attach to man than other South African Ixodidæ. The larvæ of the different species seem about equally troublesome in this respect, and make the life of some people in tick districts one of frequent misery.

THE BLUE TICK.

"Blue tick" is a convenient popular name for *Rhipicephalus decoloratus* Koch, but in reality the color of the replete female—the stage in the life cycle most commonly observed and the one suggesting the name—is nearer slate-gray than blue. This species is a close ally to the common cattle tick of America, *Rhipicephalus annulatus* Say, or, as it is more familiarly known, *Boophilus bovis* Riley. Prof. G. Neumann has stated to the writer that in a forthcoming supplement to his monograph on ticks he expects to class the South African species as a variety of the American. There are, however, a number of constant structural differences between the two ticks, as shown by Mr. Claude Fuller in the Queensland Agricultural Journal for May, 1899, pages 389–394.

The blue tick is by far the most abundant of South African ticks. It is found almost everywhere in Cape Colony, and sometimes occurs in such numbers on cattle as to quite obscure large areas of the skin. Few farmers, however, regard it as of really serious importance; and while it doubtless severely taxes the strength of animals when continually abundant on them, it does not ordinarily appear to affect their condition and certainly does not worry them to near the extent that the two larger species do. Occasionally, nevertheless, calves are reported to be stunted in growth and even destroyed. Since this species is probably the common agent for the transmission of South African redwater (Texas fever) as is surmised, it may be of interest to record that it occurs in abundance on cattle in many places to which the disease has yet to spread.

The changes from larva to nymph and from nymph to adult take place on the host. Both stages feed three or four days and then remain quiescent about the same length of time with the rostrum still affixed to the flesh. The nymph settles near the larval skin and the

adult female, too, does not usually wander far. The sexes look much alike at first despite the structural differences. The mating habits are still in doubt, but numerous females have been observed to have settled alone and to have later been joined by males. Dating from the attachment of the larva the females begin to drop in about twenty-four days, and most of them are off by twenty-eight. It takes but a short time, only a week or ten days in midsummer to prepare the dropped females for oviposition and within the limits of three summer months one life cycle may be completed and a second begun. Larvæ have been observed to remain on grass tops awaiting a host through high winds, rains, and light frosts. Over 2,000 were counted at the top of a single spear of grass.

Cattle, horses, sheep, and goats are attacked by the blue tick. It matures on all in numbers, but the cattle acquire it in greatest abundance. The progeny of specimens from a horse have been reared on a cow; that of specimens from a cow on a goat, and that of specimens from a goat on another goat. The young ticks appear practically indifferent to what part of the animal they attach, yet wander more when liberated on a beast than do the larvæ of some other species.

THE RED TICK.

The red tick, *Rhipicephalus evertsi* Neumann, takes its common name from the color of the adults of both sexes prior to engorgement. It has a wide distribution in South Africa and all classes of farm animals are attacked by it. Its attack is generally regarded as of no consequence, but some intelligent farmers attribute a temporary paralysis of the limbs of sheep and goats to it; when the particular tick responsible for the trouble is removed, an afflicted animal quickly recovers. It is rarely that an ox, sheep, goat, or horse running on unimproved grazing ground in Cape Colony is entirely free of this species of tick. Although the red tick is classified as congeneric with the blue, the habits of the two are very dissimilar. The larvæ of the red tick have a decided preference for the inner surface of the ears, and comparatively few are found elsewhere on an animal. After three or four days feeding ceases, and about the seventh day the nymph appears, as with the blue tick; but with repletion in the nymphic stage the tick withdraws its rostrum, drops, and molts on the ground, after the manner of the bont tick. The adults, in order to obtain a hold on a host, habitually rest at the top of a spear of grass or at the end of a twig and extend their forelegs when disturbed. This habit, though common to the larvæ of all the Ixodidæ mentioned in these notes, has been observed only in the adult of the red tick and two congeneric species, *R. capensis* Koch and *R. bursa* (?). Only hairless parts of an animal attract the adults, and the region adjacent to the anus draws more of them than all the remaining surface of the body. Partic-

ularly is this remarkable fact true of goats. In an experiment which involved the feeding of nearly a thousand adults on four ewes practically every specimen attached itself near the anus or vulva. The two sexes are produced in nearly even numbers from a batch of eggs. Each settles on a host without regard to the presence or absence of the other; but after a few days of feeding, if females be at hand, the males release their hold and seek mates. Unmated females cease to swell after a few days and remain less than half engorged until found by males. Mated females swell very rapidly during the day prior to their dropping, often quite doubling their dimensions. The dropping normally occurs on the sixth or seventh day. The females are then somewhat larger in all their measurements than the blue females.

OTHER IXODIDÆ.

Some species of ticks are said to be restricted to a single host or to hosts generically allied, and on this account it may be of some interest to record that *Amblyomma devium* Koch, a tick often found on tortoises and snakes in Cape Colony, has been removed from an angora goat. Two specimens only, one of each sex, were obtained as engorged nymphs. The determination of the species is by Prof. G. Neumann, to whom it may here be acknowledged I am indebted for affirmation of the determination of all the species mentioned in these notes.

Another observation worth record here has been made in regard to *Ixodes pilosus* Koch. The male of this species seeks the female and establishes himself on her ventrum with his rostrum buried in what appears to be her sexual orifice. If separated he seeks to resume the position. Mr. E. J. Wheeler, of Almwick, England, has observed this puzzling act in another species of *Ixodes* and believes it to be that of copulation. *Ixodes pilosus* is about the size of the blue tick. It has been taken from cattle, horses, goats, and hogs. It leaves its host to molt on both occasions.

THE TAMPAN TICK.

The "tampan" is an Argasid, *Onithodoros savignyi* Audouin. Its life cycle has not been traced, but among collected specimens there appear to be at least four life stages; that is, one more than occurs in the Ixodid ticks. The tampan is a most repulsive creature in appearance, with an extremely tough, leathery skin and stout, curiously sculptured legs. The sexes can be distinguished only by examining the genitalia; at least no other certain way has been discovered. When fully engorged, the female measures up to half an inch in length by almost as wide and half as thick. Horses, cattle, sheep, goats, and man are commonly attacked by this tick, and scores of specimens liberated near a confined barnyard fowl fed to repletion on that animal. The feeding habit of the larvæ has not been observed. Thirty or

forty which hatched in a cardboard box molted therein to an eight-legged form without having partaken of food. The other stages, to draw conclusions from observations on captured specimens afterwards fed on a fowl or goat, attach themselves by night or day to the host and gorge themselves to repletion in from one-half hour to two hours. They then crawl away and hide. The females alternate egg laying with feasting. The tampan is widely distributed in South Africa, and in some sections is a sore trial to travelers.

THE FOWL TICK.

The fowl tick of South Africa has been identified by Professor Neumann as the historic *Argas persicus*. It is a flattened, ovate creature, with a peculiarly stippled dorsal surface. It measures about two-fifths of an inch when full grown. Poultry, geese, and ducks are commonly afflicted with it, and death from loss of blood sometimes follows severe attacks, particularly in the case of young birds. Man is sometimes attacked.

This tick molts its skin three times before becoming adult. The eggs are laid loosely in crevices. The hexapod larva crawls to a host, affixes itself, and remains attached nearly a week. The body meanwhile distends with blood, and, toward the last, undergoes a change of form which gives it the general appearance of the later stages. When fully engorged, the larva crawls off and secretes itself in some crevice or under the bark of a tree preparatory to molting. In its later stages the tick normally visits its host in darkness, remains but an hour or two, and during this short time distends its body fully. One visit only intervenes with a molting. The adult male enlarges but little. The adult female increases all its dimensions with its first feast after the final molt, and later appears to simply fill itself out to the size then attained. It alternates feeding with egg laying. A score or more of specimens under observation and fed on a caged fowl have thus alternated feasting with oviposition four times. Intercourse between the sexes has only thrice been observed. In all three cases the male had his rostrum inserted into the female. Large numbers of both sexes have been fed and kept boxed in company, and as only the three pairs have been seen together, some observations of importance probably remain to be made. Less than three weeks need intervene between the feastings of the nymphic stages and a month those of the adults.

The vitality of the fowl tick is remarkable. It resists insecticides, even hydrocyanic-acid gas, far more than the bedbug or other proverbially hard-to-kill pests. The larvæ may be soon starved to death, but the later stages live on through months of fasting and succumb only when shriveled to a dry shell. Several have remained alive over a year in cardboard boxes on my office desk.

Mr. Southwick having invited the members of the Association to inspect his spraying outfit in Central Park, it was voted to accept his invitation and to visit the park, for the purpose mentioned, at 1 p. m. on June 23.

The next paper was presented by Mr. Scott:

NOTES ON COCCIDÆ OF GEORGIA.

By W. M. Scott, *Atlanta, Ga.*

Since March, 1898, the writer has worked the State of Georgia over with the secondary purpose of making a collection of the scale insects occurring within the bounds of the State, and the following is a list of the collected species, with brief notes on their habits.

(1) *Aspidiotus perniciosus* Comst.

This, the San Jose scale, is without question the most important species, economically, that occurs in the State, and there are perhaps more trees infested with it here than in any other State in the Union. Our records show 200 cases of this scale (principally commercial orchards), involving over a half million trees (peaches and plums). This does not include the garden and wayside cases, of which there are hundreds in some of the lower counties. These cases are distributed over 32 counties, principally in the southern part of the State, only 5 counties north of Macon having been found infested. Its food plants in Georgia are recorded as peach, plum, apple, pear, *Prunus pissardii*, rose, grape, pecan, Kilmornock willow, cottonwood, and Carolina poplar. Robinson and wild-goose plums and LeConte and Kieffer pears do not seem to be congenial host plants for this insect. These varieties, growing in the same orchards with other varieties that were badly infested for several years, never developed more than a slight infestation. In the treatment of this pest we are using 20 per cent kerosene in mechanical mixture with water on orchard trees with satisfactory results, and hydrocyanic-acid gas applied to nursery stock.

Last February and March the writer made extensive experiments with the use of crude petroleum as a remedy for this scale, proving that 25 per cent of the crude oil gives even more satisfactory results than the refined kerosene. The scales were killed when the substance was thoroughly applied and no damage resulted to the trees (peaches and plums). The pure crude petroleum killed peach trees, while 50 per cent and less did no damage.

(2) *Aspidiotus forbesi* Johnson.

This scale insect is generally distributed over the State, particularly throughout middle and south Georgia. There is hardly a bearing peach or plum orchard in the State entirely free from it and in a num-

ber of cases it has caused serious damage. It occurs on peach, plum, apple, pear, *Robinia pseudacaciæ*, and "Climbing Jasmine."

Whale-oil soap at the rate of 1 pound to 1 gallon of water, and 20 per cent kerosene, as winter washes are the remedies generally used.

(3) *Aspidiotus ancylus* Putn.

Quite generally distributed over the State on apple, oak, osage orange, *Gleditschia triacanthos*, *Ulmus americana*, and *Populus tremuloides*, but never occurs in perceptibly injurious numbers.

(4) *Aspidiotus osborni* Newell & Ckll.

Taken on *Quercus aquatica* at Atlanta, Fort Valley, Marshallville, Tifton, and Poulan, Ga.

According to Mr. Marlatt (in litt.) the distinctness of this species from *A. ancylus* is doubtful.

(5) *Aspidiotus juglans-regiæ* Comst.

Occurs very abundantly in extreme south Georgia, but rarely in middle Georgia, on peach, plum, and prickly ash. In a few instances it has been seriously injurious, necessitating treatment.

(6) *Aspidiotus hederæ* Vall.

This species occurs in south Georgia, badly infesting China trees and oleander, and is a common pest in most of the greenhouses of the State; on palms, *Cycas revoluta*, *Jasminium grandiflora*, and orange. The treatment generally adopted by florists is lemon-oil wash.

(7) *Aspidiotus ficus* Ashm.

This is a bad pest in most of the greenhouses in the State, on palms, *Cycas revoluta*, and ferns. The writer has made extensive experiments at Augusta and Marshallville on the use of hydrocyanic-acid gas as a remedy for greenhouse pests, with the result that *A. ficus* and other greenhouse insects were destroyed by the gas. No injury resulted to the common run of greenhouse plants where the remedy was properly applied.

(8) *Aspidiotus cydoniæ* Comstock.

Found in a greenhouse at Savannah on *Cycas revoluta*.

(9) *Aspidiotus uvæ* Comst.

This species is common in Atlanta on the sycamores used for shade trees. According to Mr. Marlatt, who identified the specimens, it has not hitherto been known to occur on this food plant.

(10) *Aspidiotus tenebricosus* Comst.

As a rule the maple shade trees all over the State are infested with this scale insect. The damage to these shade trees in the cities is great, finally causing their death.

(11) *Aspidiotus obscurus* Comst.

This is a very abundant species widely distributed over the State on oaks. It is quite injurious to the oak shade trees in the cities and also occurs on oaks in the forests, and on hickory at Macon, Ga.

(12) *Aspidiotus camelliæ* Sign.

Found at Augusta, Thomasville, and Okapilco, Ga., on peach, grape, heliotrope, Arbor-vitæ, and *Chilopsis linearis*.

(13) *Diaspis amygdali* Tryon.

This species occurs at Irby, Ashburn, Thomasville, and Bainbridge, Ga., on peaches and plums, and on lilac at Ashburn. It ranks next to the San Jose scale in economic importance when once it becomes established in an orchard. On October 6, 1898, the writer found this scale infesting an orchard of 25,000 peach trees at Irby, Ga.; 10,000 of these trees were fairly encrusted and in a dying condition. Being beyond the hope of recovery, they were dug up. The insects had spread to an adjoining orchard of 12,000 trees, where they were doing immense damage. The case at Ashburn involved about 1,000 trees, all of which were destroyed by this pest.

In 1898 the writer observed that the first brood began to issue the 12th of March, and by the 1st of April the young were about all hatched. As a remedy we use kerosene in mechanical mixture with water at the rate of 20 per cent applied in the fall after the foliage is shed from the trees, or 10 per cent applied in the spring immediately after the first brood has issued.

(14) *Diaspis cacti* Comst.

Occurs on cactus and pineapple in several greenhouses in south Georgia.

(15) *Aulacaspis rosæ* Bouché.

This is a common pest quite well distributed over the State on cultivated and wild roses, *Rubus occidentalis* and *Rubus villosus*.

(16) *Parlatoria pergandei* Comst.

The writer has collected this species at Cairo, Ga., on dwarf orange, and at Savannah, Ga., on *Maranta massangeana*.

(17) *Parlatoria zizyphus* Lucas.

Found on lemons from Italy exposed for sale in Atlanta and Carrollton, Ga.

(18) *Mytilaspis pomorum* Bouché.

Generally distributed over the State on apple, peach, and plum. It has proved very injurious in a few cases.

(19) *Mytilaspis gloverii* Pack.

Found at Marshallville, Ga., on orange in a greenhouse, and on *Magnolia fuscata*.

(20) *Mytilaspis citricola* Pack.

Found on dwarf orange in a greenhouse at Thomasville, Ga. It is also common on oranges from Florida exposed for sale in Atlanta, Ga.

(21) *Chionaspis furfura* Fitch.

This species has been found at Fort Valley, Marshallville, Albany, and Thomson, Ga.; on peach, plum, and apple. In the Marshallville

section it is surprisingly destructive. On April 13, 1900, the writer examined an orchard of 2,000 Robinson plums in that section that was thoroughly infested with this scale. Scarcely a tree could be found that was free from it, and most of them were encrusted from the ground to the tips of the twigs. Branches that had been killed by the scale the previous fall still retained their old leaves.

At the above date the young had apparently been hatched for several days. They covered the branches and the white filamentous wax exuded by the larvæ was profuse. No effort was made to save the trees and they were dug up; however, not before the scale had spread to an adjoining peach orchard, which became badly infested.

(22) *Chionaspis euonymi* Comst.

Found severely infesting a hedge of euonymus at Decatur, Ga. It became so injurious that the hedge was destroyed.

(23) *Chionaspis americana* Johnson.

This species is quite injurious to *Ulmus americana*, used as shade trees in Atlanta, Augusta, and Americus, Ga., and undoubtedly occurs in many other cities of the State.

(24) *Chionaspis nyssæ* Comst.

Found in great abundance on *Nyssa sylvatica* in a forest near Powder Springs, Ga. The females were confined to the trunk and branches, while the males were principally upon the leaves.

(25) *Ischnaspis longirostris* Sign.

On *Kentia belmoriana* in a greenhouse at Atlanta, Ga.

(26) *Fiorinia fioriniæ* Targ.

Found in greenhouses at Thomasville and Augusta, Ga., on *Camellia japonica* and *Cycas revoluta*.

(27) *Pulvinaria immunerabilis* Rath.

Occurs sparsely on oak, elm, and sycamore at Atlanta, Austell, and Tifton, Ga.

(28) *Pulvinaria acericola* W. & R.

On June 1, 1900, the writer examined two maple shade trees (*Acer dasycarpum ?*) in Atlanta that were thoroughly infested with this species. They were crowded on the branches, while the leaves were not so badly infested. At the date named a considerable per cent of the females had extruded their ovisacs, and, peculiarly enough, the majority of them did not migrate to the leaves. This species also occurs abundantly on *Acer pennsylvanicum* in Atlanta.

(29) *Pulvinaria amygdali* Ckll.

This coccid occurs in injurious numbers on plums at Albany, Pine City, Marshallville, and Fort Valley, Ga. It also occurs on apples at Albany, Ga.

(30) *Pulvinaria macluræ* Kennicott in Fitch.

Found on osage orange in Atlanta, Ga.

(31) *Lecanium nigrofasciatum* Pergande.

This is a common pest in south and middle Georgia, but rarely occurs in north Georgia. It spasmodically occurs in injurious numbers and is particularly abundant this season. Some large orchards in the Fort Valley section are now suffering severely from the attacks of this pest.

(32) *Lecanium hemisphæricum* Targ.

A common pest in most of the greenhouses of the State on ferns, palms, orange, and oleander.

(33) *Lecanium hesperidum* Linn.

Very common in several localities of the State, both in greenhouses and outside, on palms, ferns, *Phlox drummondii*, and *Vinca variagata*.

(34) *Lecanium tessellatum* Sign.

Found on *Caryota urens* in the greenhouses at Augusta and Savannah, Ga.

(35) *Lecanium longulum* Dougl.

Very abundant on roses in a greenhouse at Savannah, Ga.

(36) *Lecanium tulipiferæ* Cook.

An injurious species on *Magnolia fuscata* at Thomasville and Andersonville, Ga.

(37) *Lecanium armeniacum* Craw.

This species occurs very abundantly on water oak in many localities of the State, and is occasionally found on plums.

(38) *Ceroplastes cerripediformis* Comst.

Taken at Thomasville and Valdosta, Ga., on quince and *Eupatorium*.

(39) *Lecaniodiaspis tessellatus* Ckll.

This coccid occurs in great numbers on native persimmons at Marcus, Eatonton, Hamilton, and Macon, Ga.

(40) *Kermes trinotatus* Bogue MS.

The writer first collected this species on *Quercus aquatica* at Atlanta, Ga., August 21, 1899. Later, Professor Quaintance and he collected it in quantity at Tifton, Ga. Specimens were submitted to Professor Bogue, and he has described it under the above name to be published in the Canadian Entomologist. (Bogue in litt.)

(41) *Kermes* n. sp.

This species was collected by the writer on *Quercus stellata* at Atlanta, Ga., May 26, 1900, and later found at Griffin and Coleman, Ga., on the same species of oak. It occurs on the twigs and on the midrib and veins of the leaf. Specimens were submitted to Professor Bogue, who has pronounced it a new species.

CONCLUSION.

The writer in person has collected all of the 41 species recorded in this paper, besides which he has collected 7 species not yet determined, viz, two of the genus Aspidiotus, one each of the genera Chionaspis, Diaspis, Pulvinaria, Dactylopius, and Eriococcus.

The writer is greatly indebted to Mr. L. O. Howard and his assistants, Messrs. Marlatt and Pergande; also Professors Bogue, Cooley, and King, all of whom took part in the study and identification of the Coccidæ recorded in this paper.

In discussing this paper Mr. Fernald stated that he deemed it worthy of mention that *Diaspis amygdali* has now been reported from five places in Massachusetts, all near Boston, all upon trees used for shrubbery or ornamental trees of various kinds, and that in each case it has been traced to plants bought of a nursery importing direct from Japan. It does not seem to spread rapidly from tree to tree or plant to plant, but it is nevertheless very effectual in crushing out the life of the plant it is on, and has survived very severe weather.

Mr. Kirkland said there was no doubt about the nursery in question, as he had been there once or twice and had seen shipments just unpacked from Japan which were infested with *D. amygdali.*

Adjourned until 9 a. m., June 23.

MORNING SESSION, JUNE 23.

The Association met in joint session with the Society for the Promotion of Agricultural Science, the chair being occupied by President Beal, of the latter society.

PRESIDENTIAL ADDRESS.

[Withdrawn for publication elsewhere.]

The first paper read was the annual address of President Beal, which will be published in the proceedings of the Society for the Promotion of Agricultural Science.

Mr. Howard read the next paper, entitled:

PROGRESS IN ECONOMIC ENTOMOLOGY IN THE UNITED STATES.

By L. O. Howard.

[Printed in the Yearbook of the Department of Agriculture for 1899.]

The next paper, by Mr. Gillette, was entitled:

APIARY NOTES.

By Clarence P. Gillette, *Fort Collins, Colo.*

[Withdrawn for publication elsewhere.]

The next paper was entitled:

NOTES UPON THE DESTRUCTIVE GREEN PEA LOUSE (NECTAROPHORA DESTRUCTOR JOHNS.) FOR 1900.

By W. G. JOHNSON, *College Park, Md.*

Perhaps no insect in recent years has attracted more attention than the destructive green pea louse. It became conspicuous, first, on account of its ravenous attacks upon pea fields, a crop heretofore practically immune from the ravages of insects; and, secondly, from the fact that it was a species not recorded in science. What condition in nature was responsible for such a general distribution of a new species of insect the writer will not attempt to discuss in this short paper. It appeared last year, and was recorded for the first time, from Maine along the Atlantic coast southward to North Carolina, and westward to Wooster, Ohio. It was also observed in Nova Scotia and Ottawa, Canada. I had it sent to me from Massachusetts and Vermont in July and August, and complaints of its serious nature have come to me from Chillicothe, Ohio, Long Island, N. Y., portions of New Jersey, and Wisconsin (August). I first observed the pest May 18, 1899, and have had it under constant observation from that date to the present writing. I described the newcomer in the February issue of the Canadian Entomologist as *Nectarophora destructor*. A very long name, I admit, but if there is anything in a name being a burden to its possessor, we hope that this one will accomplish such a purpose.

From the first I have held that this insect is probably a clover pest. It has been observed upon both red and crimson clover, and this season hundreds of acres of red clover have been destroyed by it. In one instance, reported to me June 13, Mr. C. Silas Thomas, of Lander, Frederick County, Md., stated that the pest had almost entirely ruined 65 acres of red clover for him. Many other cases of a similar nature were reported or observed by us. The attack has been very common upon crimson clover also, but I have not heard of a field being killed by it. That clover, and perhaps the red clover, is its original food plant seems quite conclusive from our experiments and observations. I am of the opinion that red clover is its original food, and that it is, therefore, primarily a clover pest. Without doubt it is a native American insect, and has spread its attacks to crimson clover and field peas, as these two plants have encroached upon the feeding ground of the louse. It spends the winter, at least in the South, as an adult in clover fields. It may winter in another form farther north.

It is barely possible that this insect has other food plants and lives over winter upon them, but clover is, no doubt, the main plant upon which it lives. Mr. F. H. Chittenden, of the U. S. Department of Agriculture, Division of Entomology, in Washington, observed this

insect, or one very closely allied to it, feeding upon a number of species of vetches in Washington this year. From a long series of experiments here in the laboratory we have shown that there are two kinds of females known at present, the winged and wingless forms. No male has as yet been discovered, and perhaps in the South none exists, and the insect remains over winter in the adult stage, as stated above, upon some plant, and in most instances this is clover. The female produces living young which reach maturity in from ten to fifteen days, and possibly less time in hot weather. As an example, a young one born March 4 reached maturity (winged form) March 16, or twelve days from time of birth, and was producing living young on March 19. From March 19 to April 17 it became the mother of 111 young, and died on the latter date. Her first young (wingless form), born March 19, reached maturity and was producing on March 31, or eleven days from time of birth. From March 31 to April 13 she gave birth to 120 young and died. We have made many other observations of a similar character, but this will suffice to show the rapid reproductive powers of this insect, and we might state that in many instances where this insect was first observed May 1, three weeks later the fields were abandoned on account of its attacks. Calculating from the average number of insects produced per day (which is 6) in six weeks one would become the progenitor of 423,912.

It was estimated last year that the total loss from the attacks of this creature along the Atlantic coast States was $3,000,000, and that the crop was estimated at only one-half the usual output. From close communion with the largest growers, the most experienced seedsmen, and most extensive business men in this line of business, The Trade, a canned-goods journal published in Baltimore, has gathered the information that the crop of peas of the Atlantic coast this year will not exceed, on the outside, one-third of what it was last year. This is about as serious as it can be, when it is taken into account that it is mostly due to this one pest, and that it is certain to increase its destructive powers from year to year, unless some factor in nature intervenes to check and retard its further development. With this condition of affairs it is not strange that farmers have become thoroughly discouraged, and make the statement that they will be more cautious about planting peas for market purposes or for the packer in the future. With this year's experience, however, we have shown conclusively in our experiments and practical work in the field that this insect can be kept in control to a very great extent if taken in hand in time. In the first place, the peas must be planted in rows 24 or 30 inches apart, as shown in the illustration (Pl. I, fig. 1), and not broadcast or in drills, as has been the case over a wide area throughout many of the Southern States. As an illustration of this we might cite an instance on the place of Mr. C. H. Pearson, a large packer of Balti-

FIG. 1.—SPRAYING PEAS WITH TOBACCO-WHALE-OIL SOAP, SHOWING METHOD OF PREPARATION AND APPLICATION.

(Author's photograph.)

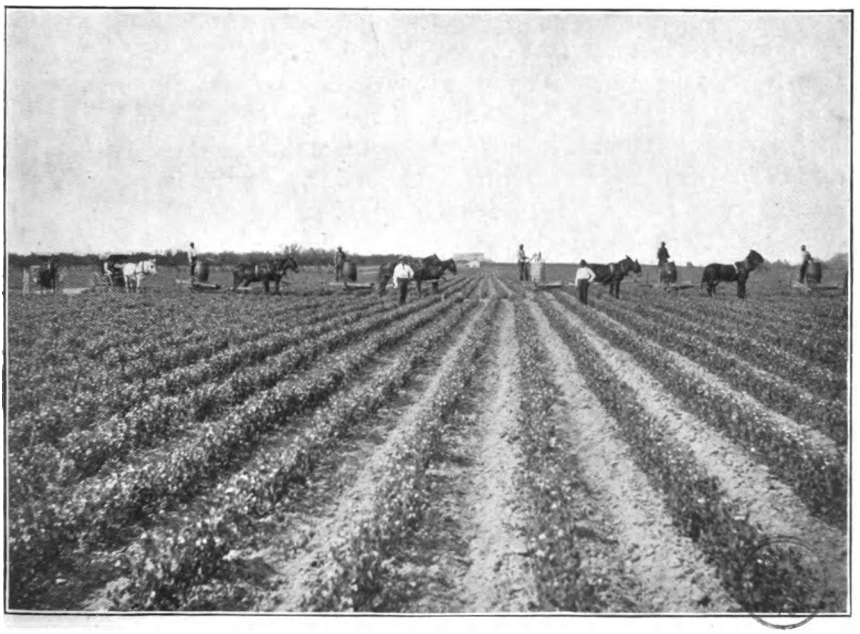

FIG. 2.—SECTION OF A 600-ACRE PEA FIELD. ROWS ONE MILE LONG, SHOWING SPRAYING OUTFIT READY FOR WORK. PEAS FINALLY SAVED BY BRUSH-AND-CULTIVATOR METHOD

(Author's photograph.)

FIG. 1.—FIELD OF PEAS SAVED BY BRUSH-AND-CULTIVATOR METHOD, SHOWING IMPLEMENTS USED.

(Author's photograph.)

FIG. 2.—FIELD OF PEAS SAVED BY THE BRUSH-AND-PAN METHOD, SHOWING THE APPARATUS USED.

(Author's photograph.)

more. His 600-acre pea plantation was practically saved by persistent and energetic efforts on his part this season. All the methods from a practical standpoint were tried on this place, and it was found that the brush and cultivator method (see illustration, Pl. II, fig. 1) was the most effective. Forty men were therefore engaged to work in the field, and the 600 acres were brushed and cultivated every third day for a period of two weeks, and in this manner the entire field was saved, netting the owner from 25,000 to 30,000 cases of peas of 2 dozen each. It is a fact which is not questioned by those who are familiar with this plantation that had not this persistent and energetic fight been followed, the greater portion of the peas would have been destroyed by the insect. Last year the peas over the same area were broadcast, so there was no opportunity of fighting the pest, and as a consequence 480 acres were entirely ruined by it, as reported last year before this Association (Bul. No. 20, n. s., Div. Ent., U. S. Dept. Agr., p. 94). This year, by changing the method, and by a new system of fighting the pest, the peas have been saved. Many other illustrations of a similar nature could be given where we have been following this method persistently in this State.

The brush and cultivator method is a simple one, and the implements for this method are shown in the accompanying illustration, Pl. II, fig. 2, which represents a field of peas which was saved by brushing and cultivating. We might state, however, that a field not far distant from the one shown in the figure, where nothing was done, was totally ruined by the pest. A good pine switch is used to brush the vines backward and forward ahead of the Iron Age cultivator, drawn by one horse, and in this manner the insects are covered and a very large proportion of them destroyed. The cultivation should not be repeated until the third day, as it requires usually something over forty-eight hours for the destruction of the adult insects when covered with earth. On this plantation we also sprayed a large acreage to show the practical side of this work, and the outfit just ready to begin work is shown in Pl. I, fig. 2. Suffice it to say that we have found that no spray can be used which can destroy a percentage of insects large enough to warrant the expense of the operation. In this instance we sprayed 100 acres in two days, and thoroughly tested the method from every standpoint, using various materials. We abandoned the spraying apparatus, and began the brush and cultivator method, which was followed up persistently, with the results already noted. We have also used the "brush and pan," as shown in the illustration (Pl. II, fig. 2), in which instance a bushel of lice were caught to each row, 125 rods long.

Many natural enemies, such as parasitic and predaceous insects, have been found feeding upon this pest in the fields, and in this manner, no doubt, the number has been somewhat reduced. The most important factor, however, we have observed in the destruction of this pest has

been the fungous disease, *Empusa aphidis*, which was common the early part of the season upon this insect, in both clover and pea fields. It is a contagious disease, and destroys the pest in very large numbers, under certain conditions. In one instance we found 58 dead lice upon the under surface of a single lobe of a clover leaf, and it was not an uncommon thing in June to find 15 or 20 dead lice upon the under surface of a pea leaf. With the rains which prevailed throughout this section during June, which fostered the development of this disease, it spread rapidly throughout the infested fields, and as a consequence it was very difficult to find the pea louse upon late peas. A careful examination of peas where the insects were abundant in June showed that they were practically free from them. We feel, therefore, that the climax, as far as the development of the insect this season, has been reached, and that these silent factors in nature are now actually reducing the pest to such a point that it may possibly be several years before it will be such a destructive pest in this section as it has been for the past two seasons. At any rate, the conditions are such that the farmer and canner have taken new hope, and we trust the future will bring fewer lice and more peas.

In discussing this paper Mr. Hopkins said it would be interesting to know whether it is possible for this to be an introduced pest, and asked Mr. Johnson whether he had made any investigations in that respect.

Mr. Johnson replied that his opinion is that it is not an introduced pest but an indigenous insect, and that the change of conditions has brought about this enormous development in numbers.

Mr. Hopkins asked if there are any records of its previous occurrence in great numbers.

Mr. Johnson stated that the only record he has is one by Mr. Beckwith, formerly of the Delaware station, made ten or twelve years ago, and the record of its occurrence along the Potomac River in 1887. In neither case however, are we sure that it is the same insect, as specimens are not available. The growers of Maryland, Delaware, and Virginia state now that this insect has been known to them for a number of years.

Mr. Hopkins said this case is such a complete parallel to the invasion of the pine-bark beetle, which has been fully presented and published and the trouble from which is now over, that it occurred to him that in this case within the next few years this insect will probably disappear or become exceedingly rare. He had taken the trouble, in connection with the investigation of the pine insect, to look up the history of invasions by indigenous insects and found that they multiply rapidly for several years, become enormously destructive, and a

few years later disappear. They are destroyed by parasites or by climatic conditions and soon become rare species. This happened in the case of the pine insect, which was scarcely heard of before, and was one of the rarest insects in collections until it suddenly occurred in 1891 in such enormous numbers as to destroy millions of dollars worth of timber, but now it is practically extinct. Not a single living specimen has been found since the fall of 1892. Professor Johnson's paper shows the great importance of the work he has undertaken, and his experience will be of inestimable value in dealing with future outbreaks of the pea louse. He thought the farmers of Maryland would make a great mistake by changing their locations for growing peas until perhaps a year has elapsed, because if the rule follows in regard to sudden invasions by indigenous insects they will soon disappear or become rare.

Mr. Johnson said he was greatly obliged to Mr. Hopkins for his opinion, but there is so much money at stake that the growers could not let the matter rest awaiting nature's relief. He believed fungous diseases, especially *Empusa aphidis*, is one of the factors which will bring about the temporary disappearance of the pest.

Mr. Galloway said the point in regard to the appearance and disappearance of forms holds good in fungous attacks also, the most striking example being the potato blight. The same holds good in the passing of the Russian thistle. These things come and go and come again, and the principle holds good with fungous diseases as well as with insects.

The next paper, by Mr. Galloway, was entitled:

PROGRESS IN THE TREATMENT OF PLANT DISEASES IN THE UNITED STATES.

By B. T. Galloway, *Washington, D. C.*

[Printed in the Yearbook of the Department of Agriculture for 1900.]

The next paper, by Mr. Webster, was entitled:

METEOROLOGICAL INFLUENCES ON THE HESSIAN FLY.

By F. M. Webster, *Wooster, Ohio.*

[Withdrawn for publication elsewhere.]

The meeting then adjourned to Central Park to inspect Mr. Southwick's spraying outfit.

AFTERNOON SESSION, JUNE 23.

Owing to the large number of papers to be read, it was resolved that each author be allowed ten minutes in which to present an abstract of his paper, and that all discussions be postponed until the papers had been presented.

The following papers were then presented:

HYDROCYANIC-ACID GAS AS AN INSECTICIDE ON LOW-GROWING PLANTS.

By E. Dwight Sanderson and C. L. Penny, *Newark, Del.*

The desirability of using a gas as an insecticide upon low-growing plants, more especially for plant lice, but also for some leaf folders and other insects which can not be reached by means of a spray, has long been apparent to entomologists.

So far as known the only work previously done upon this problem is that of Prof. H. Garman, who seems to have been the first to suggest such use of a gas, with carbon bisulphide upon the melon louse, mentioned at the meeting of this society in 1893, and his subsequent experiments with hydrocyanic-acid gas in 1894 (Bul. 53, Ky. Agr. Exp. Sta.), and the further experiments of Dr. J. B. Smith with carbon bisulphide upon the same insect in 1895 (Bul. 109, N. J. Agr. Exp. Sta.). It is believed that neither of these gentlemen, however, have perfected practical apparatus, nor outlined a method for its extensive use in the field.

Two years ago, under the direction of Prof. W. G. Johnson, we did considerable work with hydrocyanic-acid gas in tents and box frames over trees, and in boxes for nursery stock, in combating the San Jose scale. In one instance several hundred young trees were fumigated with flour barrels. Young apple trees were also fumigated for plant lice with marked success. Having read the experiments by Professors Garman and Smith, this experience with the gas led me to attempt the problem of applying it to use upon low-growing plants during the past spring.

Carbon bisulphide has not been tried, as the trials already made, including also some recently recorded by Professor Webster, showed that it was very much slower in its action, a serious obstacle to its extensive use. This point might indeed be overcome by using a larger number of coverings, but a large investment in apparatus would preclude its use in many instances. Where carbon bisulphide requires an hour to kill plant lice, hydrocyanic-acid gas takes but ten minutes. Thus in use upon melons, with a cover for each plant, with 100 covers hardly more than 1,000 plants could be fumigated in a day with carbon bisulphide, while five or six times as many could be treated with hydrocyanic-acid gas. As regards cost of chemicals there is not much difference, though, if anything, carbon bisulphide is slightly more expensive. Both gases are dangerous poisons, but, all things considered, I believe that hydrocyanic-acid gas is possibly preferable to carbon bisulphide in this respect. There is but little danger with hydrocyanic-acid gas in such small quantities in the open air, the greatest danger being in

handling the salt solution, and though CS_2 is not as poisonous, it is highly explosive.

For fumigating individual plants the apparatus needed and method of generating the gas was soon ascertained. For small melon and cabbage plants we had made small paper covers, under which the gas is generated. These are pyramidal in shape, the apex being 8 inches high, and the paper fastened to the inside of a wood frame 3 inches high by 20 inches square, which forms the bottom. This frame is sharply beveled on the lower edge, to enable one to firmly plant the cover in the soil. A good quality of building paper is used for the top and is cut in one piece, so that there is only one seam. The materials for these covers cost from 3 to 4 cents, and we are having fifty made for $6. In the field the covers are easily handled, as they rest one within the other.

We have found that in using potassium cyanide a small amount in solution is much superior to the dry salt, it being more easily measured and handled. Furthermore, in first mixing the acid and water and then dropping in the salt much of the heat necessary to the generation of the gas is lost by radiation before the salt can be thrown in, no matter how quickly the generation be performed. By dissolving 100 grams of KCn in sufficient water to bring the solution up to 200 cc., when finished a solution is secured which is of good strength and one of which different amounts can be easily computed, 2 cc. equaling 1 gram KCn. To generate the gas a one-fourth dram (8 cc.) vial is filled with the KCn solution and an equal or slightly less amount of sulphuric acid placed in the bottom of a 2-dram vial. The larger vial is thrust deep in the earth, being careful to place it so that the overflowing acid will not strike the plant or cover. The smaller vial holding the cyanide is then dropped into the acid, mouth down, and the plant quickly covered and the cover firmed down. The capillarity of the one-fourth dram vial prevents a too sudden generation of the gas and allows time for placing the cover. The vials are carried in carriers holding one hundred or more, as desired. These are made of a piece of board for the bottoms, in which two hundred holes the size of the vials have been drilled, on the bottom of which a piece of wire netting is tacked. With sides and a hinged cover these make handy and safe trays. No stoppers are used, but a piece of rubber packing inside the cover of the tray would serve the same purpose.

As regards the amount of cyanide to be used and the length of time necessary to kill plant lice and other insects, there has not yet been opportunity for sufficient tests to give conclusive results. From some 75 tests made, we believe that a one-fourth dram vial of the above-mentioned solution (or about four-tenths gram KCn per cubic foot air space) with an equal amount of acid for ten minutes will be found entirely satisfactory. In some tests upon young canteloupes which

were covered with water after a slight shower we found that they were badly injured by this strength, though we doubt they would have been hurt had they been dry. Possibly a less time may be sufficient, but we doubt that in handling fifty or one hundred covers it would be of much advantage, as they could hardly be changed and the gas generated in less time. The very much larger amount of gas than is necessary in a larger box or frame is due to the relatively large soil surface, and the fact that more or less necessarily leaks out around the edges at the bottom. In using these covers for such insects as melon lice it would rarely be necessary to fumigate every hill. But were every hill fumigated, with hills 5 by 5 feet, the chemicals for the treatment would cost not over 75 cents per acre, and with one hundred covers two men should be able to fumigate 3 to 5 acres a day. Upon the first opportunity we shall try this treatment with fifty or one hundred covers over an acre or two during the present season.

The fumigation of plants grown in rows is, however, more difficult, and presents some obstacles. A frame 15 feet long, with two sides slanting so that in cross-section the frame was triangular, 20 inches wide at the open bottom and 8 inches high, was first used, but it was soon found, as had been expected, that the gas would not diffuse readily in such a shaped covering.

It seemed desirable, therefore, to determine the exact manner of diffusion of the gas in such an elongated frame, and also points as regards (1) the amount of gas produced by a given amount of KCn, sulphuric acid, and water, (2) the influence of the soil and wet plants upon the strength of the gas, and (3) whether the strength of the gas deteriorates after a given time. This work was taken up by the station chemist, Mr. C. L. Penny, who has very carefully secured and analyzed samples of the gas under various conditions to determine these points. Only a mere summary of the results can now be given. During the present summer we purpose studying the manner of diffusion of the gas in a room such as nurserymen use as a fumigatorium, and later will publish a detailed account of all the experiments.

A frame covered with rawhide paper, 13½ feet long and 18 inches square at the ends, was constructed for this work. The bottom was taken off and the frame aired after each test, and sealed with putty when replaced. The gas was generated by running the acid into the cyanide solution by means of a stopcock so that there was no possibility of loss or leakage. A known amount of gas was drawn off—after passing through a drying tube—into several large bottles, by first exhausting these with an air pump. A 36-gallon kitchen hot-water boiler was nearly exhausted of air, and a mercury gauge attached. Between this and the reservoir of bottles was placed a train of wash bottles containing nitrate of silver solution, and all were then connected. Upon opening a valve the larger tank thus drew a quantity of the gas through the wash bottles whose volume was easily determined by the mercury

gauge and whose content of gas was subsequently determined by titration. The gas was generated at the middle and either ends of the frame and samples taken from all of these and opposite points after different lengths of time. A solution of cyanide and sulphuric acid in proportion of 1 part cyanide to 1½ parts acid to 2¼ parts water and an amount equal to two-tenths gram potassium cyanide per cubic foot air space was used in all of these tests. The amount of cyanide remaining in the residual solution was determined in each instance and deducted from the amount calculated to be present if the gas were completely generated and diffused. With this frame the residuum averaged about 5 per cent; with a large box, mentioned below, about 3 per cent, and the percentage was found to decrease the more time elapsed after generation. With the generator and intake at the same end after three minutes it was found the amount varied from 70 to 197 per cent of the calculated amount with an average of 13 per cent. In other words, the gas diffused irregularly, but remained largely in the end where generated. The generator was then placed at the middle and the intake at the end. Samples were taken after ten minutes, thirty minutes, one, four, and twelve hours. In all of these the gas was found to diffuse irregularly and in no instance was the diffusion nearly complete. As far as could be detected the frame was tight, but a loss of gas seemed to occur in some way, whether by leakage or transfusion is a question. At any rate, after twelve hours not a trace of gas was found. The average percentages of the calculated amount for the four other periods were 46, 41, 27, and 13 per cent, respectively, showing a regular decrease the longer the time, but never a complete diffusion, the highest amount after ten minutes' time being 70 per cent.

From these tests it seemed evident that by itself the gas would not diffuse evenly in such a frame. A rough fan was therefore put in the center, and a diaphragm placed horizontally through the center to within a foot of each end, so that a thorough circulation might thus be secured mechanically.

By use of this mixer with the generator and intake at opposite ends after five minutes 72.4 per cent of the calculated amount was secured, and this with fairly constant results, only varying from 68.5 to 75 per cent in four trials. As this fan was far from a perfect device, and also promoted leakage, we concluded that these tests showed fairly that in such a shaped frame the gas diffuses entirely irregularly and never completely. In other words, it would be necessary in actual usage to generate a very much larger amount of gas than necessary were it diffused, in order to secure a sufficient amount in all parts to be effective, with the danger of burning the plants at the point of generation if used too strong. Evidently the only way to determine this was by tests in the field upon insects, as such a fan arrangement was clearly impracticable.

To determine the influence of wet plants on the amount of gas, a half-bushel of leaves were sprinkled, shaken, and placed in the frame. After five minutes only 54.3 per cent of the calculated amount of gas remained, or 75 per cent of what would have been secured without the leaves. In other words, the moisture absorbed one-fourth of the gas. This influence of moisture must needs be considered in the fumigation of nursery plants packed in wet moss, or sprinkled, or in field work after a rain or heavy dew. The bottom of the frame was then removed and the gas generated over soil containing an average degree of moisture. After five minutes 45 per cent of the calculated amount was found remaining, or 62.7 per cent of what would have been secured were the box closed. Thus the soil and possible leakage, which was slight, as the soil was well banked and packed around the bottom, took up three-eighths of the gas generated. This influence of the soil upon the amount of gas is very important in the use of these frames with a large surface exposed to the soil, which, of course, decreases the ratio of the soil surface to the volume of the gas.

The diffusion of the gas in a wooden box which had been made for fumigation of nursery stock was then tested. This box is 8 by 3 by 2½ feet, and was made of two thicknesses of matched flooring, with building paper between. The lid fitted tightly and the joint was sealed with putty. With the generator and intake at the same end, at the end of two minutes 33.7 per cent of the calculated amount was found; in ten minutes, 62.7 per cent; in twenty minutes, 56 per cent. With the generator and intake at opposite ends, however, 265 per cent was found in two minutes, 160 per cent in five minutes, 92 per cent in ten minutes, and 9.5 per cent in sixteen hours. Thus the diffusion of the gas in this shaped space is just the opposite of that in a long frame—that is, in the cubical space the gas is puffed to the opposite end at the end of two minutes, but about one-third being at the end of generation and two-thirds at the opposite end, and requiring about ten minutes for the complete diffusion, while in the long frame the gas became "banked" at the point of generation, and is never completely diffused without a mechanical agitation.

These in brief are the facts drawn from the laboratory study of the diffusion. How were they supported by experiments in the field?

It must be remembered that in the field tests a larger amount of gas would be required to compensate the influence of the soil and foliage. The triangular frame 15 feet long by 8 inches high by 18 inches wide, with a door at the center to admit the generator, was first used. It will be noticed that this frame has but about one-fourth the area in cross section of the square frame used at the laboratory, and therefore the diffusion would be at least inversely that much more difficult. With two-tenths gram KCn per cubic foot air space all lice were killed at the middle of the frame in ten minutes, the generator being

at the middle. Neither with this strength at ten, fifteen, or twenty minutes were the lice at the ends of the frame even stupefied, but with three-tenths gram KCn per cubic foot many of the lice were stupefied at the ends in ten minutes, but all soon recovered. With three-tenths gram for fifteen minutes, however, the lice half way between the middle and ends were killed.

This frame was not only too long and of too small diameter for the diffusion of the gas, but was too long to be readily handled and to accommodate itself to any unevenness of the ground. A frame 10 feet long by 10 inches high by 24 inches wide at the bottom, also of a triangular shape, was therefore made, but with doors at either end instead of one at the middle. In the tests made with it one-half of the gas was generated at either end instead of from the middle. In these frames the cyanide solution and acid can be measured and handled in larger vials, and these carried in trays, as for the small covers. A 3-dram long-style vial five-sixths full of the cyanide solution (2 cc. equals 1 gram KCn) and 8-dram short-style vial, with 2 cc. sulphuric acid in the bottom, give one-half the amounts necessary for three-tenths gram KCn per cubic foot in this 10-foot frame, one generation being made at each end of the frame. By using these vials the carrying and cleaning of a separate vessel in which to generate the gas is obviated. Using two-tenths gram KCn per cubic foot, after ten minutes five tests showed an average of 16 per cent of the aphides alive at the ends and 25 per cent alive at the middle, or that the gas was but slightly more effective at the ends than in the middle, and was insufficient to kill the lice at either point. All of these lice were stupefied and remained so for some time, but were found alive the next morning. In this connection it might be well to state that in such tests plant lice should always be kept at least for twelve hours. They have a remarkable power of "playing possum," and will often remain stupefied for three or four hours. The same dose for five minutes left 37 per cent alive at the ends and 17 per cent in the middle, showing the gas to have been more effective in the middle. This shows a similarity in the diffusion to that found in the large box used in the laboratory in that the gas was at first thrown from either end to the center and was found to be more effective in the middle than at the end after five minutes, but this became so diffused that the gas was slightly more effective at the ends after ten minutes. Three-tenths of a gram KCn per cubic foot for five minutes also failed to kill the lice. Later three-tenths and four-tenths of a gram per cubic foot were tried for ten minutes, and only in one or two instances did we find from 10 to 25 per cent alive when the former strength was used, and four-tenths of a gram killed all the lice and other insects in every test. Three-tenths of a gram for fifteen minutes would undoubtedly be effective. With none of these strengths were the strawberry plants upon which the

work was done injured. In fact, from the results of fumigating plants before setting them out, we believe that strawberry plants in the field would stand a strength of two-tenths or three-tenths of a gram KCn per cubic foot for twenty or twenty-five minutes, were that necessary.

Work done with a wooden box 2 by 2 by 2½ feet, with open bottom, in fumigating loose strawberry plants infested with *Aphis forbesi* brought out the influence of the soil on the gas and the ready diffusion in a cubical space. In this box two-tenths gram KCn per cubic foot in ten minutes, three-tenths gram in five minutes, and one-tenth gram in twenty minutes proved fatal to the aphides.

Thus, in the 10-foot frame, with a soil surface of 20 square feet and a cubic capacity of 8⅓ feet, or a ratio of 2½ soil surface to 1 of volume, just twice as much gas was required to be generated from two points to be effective as that in the wooden box of 10 cubic feet capacity and 5 square feet soil surface, having an almost opposite ratio of 2 volume to 1 of soil surface. Again, the covers for individual plants, with a soil surface of about 3 square feet and a capacity of one-half cubic foot, or a ratio of 6 soil surface to 1 of capacity, required eight-tenths gram per cubic foot, or four times as much. Comparing these figures with the results obtained in the laboratory test of the influence of the soil, by a rough calculation a rule somewhat as follows might be deduced: Let x equal the mean height in feet: then the amount of cyanide of potassium per cubic foot expressed in decigrams would be 2 plus the reciprocal of x, or the decigrams of KCn to be used per cubic foot equals $2+\frac{1}{x}$.

Whether these ratios would hold true for a larger series of tests remains to be ascertained, but they at least indicate the general tendency of the diffusion of the gas and the influence of the soil upon it. The cost of such frame is but little. The materials for them should not cost over 25 or 30 cents, and they are easily made. With rows 3 feet apart, using 12 frames, with three-tenths gram per cubic foot for ten minutes, an acre could be covered in about two days at a cost of about $3 for chemicals. This treatment is practicable, therefore, only upon plants of some considerable value and for relatively small areas. Under many circumstances, however, it could be used to much better advantage than any other means of combating a pest, and often might be found effectual where no other method of extermination were possible.

NOTES FROM DELAWARE.

By E. Dwight Sanderson, *Newark, Del.*

The harlequin cabbage bug.—The harlequin cabbage bug has been under observation as much as the scarcity of material would permit. Last year the bugs were not noticed till late in the summer, and injury by them, as noted in one or two instances, was confined to very late

cabbage. The present spring they have also been unusually scarce, though more abundant than last year. April 25 I found the sexes pairing on kale at Smyrna, and a few eggs already deposited. Several pairs were brought to the insectary. The mating of the sexes takes place at frequent intervals, often for the larger part of a day, during the period of a month or more. One female, with which was placed a male from May 1 to June 1, deposited fifteen clusters of eggs in that time. Another female, which mated on April 29, and was then placed alone, deposited six clusters of eggs up to May 19. The young from eggs laid May 1 became full grown June 19.

The appearance of this insect in the spring seems to be somewhat irregular. At Camden, May 12, I found but one or two stray females on some kale next to where a patch of late cabbage was fairly alive with bugs last fall, and where the same cabbage had been stored all winter. At Milford none could be found until May 29, when one or two were found here and there on the cabbage grown up to stalks, where were one or two clusters of eggs. One of our largest cabbage growers tells me that a few years ago it was almost impossible to raise cabbage on account of this insect, but that for the last few years he has used kale as a trap crop with the best of success, having very little trouble in thus catching the old bugs, and as a result of this procedure and the careful hand picking of the few that stray to the cabbage, during the last two or three years he has been troubled but very little, while his neighbors' cabbage has often been ruined.

On March 21 I received partially grown lots of *Gastrophilus equi* through our veterinarian, Dr. H. P. Eves, which, it was thought, had caused the death of a horse. The bots were taken from the stomach, which was full of them and was badly ulcerated. Dr. Eves stated that here and there the stomach and intestines had clearly been perforated by the bots, and the scars made by them were found throughout the length of the intestinal canal. A week later Dr. Eves sent me bots of *G. nasalis*, most of which were found in the esophagus of a horse.

The rose-chafer (*Macrodactylus subspinosus*) has been much less numerous than usual this year, as has the plum curculio (*Conotrachelus nenuphar*). In fact, but few of our fruit growers have resorted to "bugging," as they term hand picking and jarring.

Apples are being largely planted in Delaware, and the insects affecting them have been quite an annoyance, especially on young trees top worked by budding.

Aphis mali Fab. attacks the buds as soon as they commence to swell in the spring and often seriously stunts their growth or kills them. The eggs of this species commenced hatching on April 15, and the last hatched about May 7. These became less numerous late in May and had nearly disappeared by the middle of June, being largely destroyed

by larvæ of *Syrphus americanus* and parasites, among which is *Lysiphlebus myzi* Ashm. At several points the eggs of this aphis were very abundant, but few lice appeared and did but little damage.

Myzus sp. ?—During the last week in April the stem mothers of an aphis, determined by Mr. Th. Pergande to be a species of Myzus, were found depositing young with *A. mali.* These stem mothers were large, globular, bluish-black, slightly pruinose, and the young were of a light-brown color. This species curls the leaves much worse than the former, and has been found very common on apples throughout the State. On June 16 I found that they had been destroyed in one badly infested orchard mostly by parasites, among which were *Lysiphlebus cucurbitaphidis* Ashm., and some undetermined species, and also by syrphid larvæ and *Chilocorus bivulnerus.* The adults of the next generation are of a brown color, marked with yellowish where the embryos show through the abdomens. The larvæ, pupæ, and nearly molted adult apterous forms of the next generation are of a decided pinkish color, while the winged individuals are of a brownish-black color. The following generation is also partly composed of winged aphides.

Aphis sp.—Late in May an undetermined species of *Aphis* spreads to the apples from wild-cherry trees and soon becomes thickly clustered upon the terminals. This species is bright yellowish and green, prominently marked with black.

Lophoderus quadrifasciana Fern.—As the buds commenced to unfold in April, fine silk threads could be seen running here and there between the terminals. These were found to be made by small, yellow Tortricid larvæ, evidently just hatched from the eggs. Later these became a bright green color, and when full grown were about 10 mm. long. They pupated May 16 and emerged May 25 to June 2, the species proving to be *Lophoderus quadrifasciana* Fern, one not previously noted as an apple insect. The larvæ were quite common, and did more or less damage by webbing the leaves together.

The larvæ of *Penthina chionesema* Zell. have similar habits and have previously been noted as apple pests in Missouri by Miss Murtfeldt. The larvæ are so similar to the latter species that they were not distinguished, though I find subsequently that they are considered larger. A larva of this species pupated May 14 and the moth emerged May 22.

Larvæ of *Cacœcia rosaceana* Harr., are common, but not sufficiently so to do much injury. Moths emerged May 30.

Cases of *Mineola indiginella* Zell. were found very common during the winter, but I did not observe much work of the larvæ in the spring. They pupated about May 15 and the moths emerged the first week in June.

A small, reddish larva was observed to do considerable damage by boring into the young buds, but I failed to rear it. Mr. Busck thinks

the larvæ may be a species of Depressaria, and I now have larvæ which I think are the second brood of the same species. This species was parasitized by *Microdus gibbosus* Say.

Tmetocera ocellana has not been observed, though it has sometimes been injurious in Delaware.

Steganoptycha sp.—During the latter part of last summer the terminals of young apple trees were very generally injured by a small, reddish larva boring into them. These larvæ became full grown late in October and then hibernated in their burrows in the terminals, usually at the base of a leaf petiole which remained attached over winter. In some cases the burrows were slightly lined with silk. The hibernating larvæ became somewhat flattened and reduced in size and of a lighter color. Were a twig broken open the larvæ would close the opening with silk and chips, and one or two spun whole cases of silk upon the outside of the twig when thus molested. I also found a similar case on a branch of one tree. Fully 50 per cent of the larvæ in the orchard under observation were parasitized by *Bracon mellitor* Say, whose larva makes a white, parchment-like cocoon of silk within the burrow. All terminals containing parasitized larvæ were found to be punctured by a small hole just below the cocoon of the parasite. Whether this was caused by the oviposition of the parasite or is for its exit I do not know. These larvæ pupated May 5 to 7 and the moths emerged May 16 to 23. They have been determined by Mr. Busck to be the same as *Steganoptycha salicicolana* Clem. of the U. S. National Museum collection, but he states that these specimens are probably wrongly determined. The species is doubtless the same as that found by Miss Murtfeldt in Missouri, which she describes as *S. pyricolana* Riley MSS., stating that Dr. Fernald considered it identical with *S. salicicolana* Clem. As the larvæ of the latter species, however, have been recorded as breeding in willow galls, it seems hardly probable that they are the same, and Dr. Riley, who Miss Murtfeldt states had types of Clemens' species, pronounced them distinct. The moths are very pretty little insects of a gray-brown color, with bluish reflections, and marked with bands of silvery, lead gray, and black scales. This species is very common throughout the State and has done considerable injury in some instances. *S. salicicolana* Clem. was originally from Dr. Walsh in Illinois, and I find no other mention of it except by Miss Murtfeldt.

The destructive green pea louse.—A considerable portion of the last two months has been devoted to a field study of the pea louse, *Nectarophora destructor* Johns.

Last year I found the lice still breeding on peas at the station on December 1. The first to be observed this year were seen on May 1, when, after considerable search, I found a few full-grown wingless females on early peas at Milford. On May 11 the lice were found to

be very abundant upon crimson clover throughout the State. In several instances they were observed spreading to the peas. With rare exceptions, however, they spread only to the late peas, and almost all our growers had first-class crops of early peas. One or two fields of crimson clover immediately next to pea fields were fairly alive with lice, and though none could be found on the early peas they were spreading on to the late varieties. At this time but few lice could be found on red clover. By May 22 the lice had become quite thick on the late peas. Fields sowed in 8-inch drills were found to be much worse infested than those in 30-inch rows, and subsequently were much worse injured. In fact, both early and late peas sown in drills or broadcast were a practical failure. One acre of market garden I saw had hardly a pod formed; on another field of 20 acres of Alaska and Admiral about 1,000 pounds of peas were secured and the rest was cut for fodder or turned under. By this time (May 22) most of the clover had been turned under, and the lice had left that which remained standing. They now became more common on red clover throughout the State, but never very numerous. In fact, pea lice could now be found everywhere and on everything. On squash vines, apple trees, in every fence-corner cobweb, could be found the ever-present, stray pea louse.

Not until the first week in June did the enemies of the lice commence to check their increase, and though they soon multiplied so rapidly, and did such efficient service, that but few lice were to be found when the late crop was being cut on June 18, still they were too late to benefit the pea crop, as the injury had already been done. As a result the late varieties have probably yielded about one-fourth of a crop on the average, the yield varying from absolutely nothing to a full crop. The lice have been fewer in numbers and have done less injury than last year, as last year considerable injury was done the early crop. Had it not been for the cool, wet weather of the latter part of May, the injury would have been much more severe, but this doubtless prevented a more rapid reproduction of the aphides.

Possibly the most important enemy of the lice was the fungus *Empusa aphidis*. Individuals killed by this were found commonly on clover early in the season, but not in any number. Not until June 11 were diseased lice found in quantity, but on that date it was apparent that the fungus would soon kill the larger part of them, as many were dead and the majority were affected. A week later but very few lice were found, and almost all were diseased.

Parasitized aphides were fairly common on the crimson clover, but none were seen on peas until June 11. At least 5 per cent were killed by parasites whose identity has not yet been determined. Last fall several *Aphidius washingtonensis* Ashm. were bred.

Syrphus flies were not abundant until May 30, when they were very common and ovipositing. Nine-tenths of them were *Syrphus americana* Wied., and the remainder *Sphærophoria cylindrica* Say. and *Allograpta obliqua*. *Bassus lætotorius* Fab. was also quite common, and later almost all of the puparia of *A. obliqua* were found parasitized and the parasites bred from them. On June 11 no syrphus flies were seen, but on the 18th a third brood had appeared and were swarming over the field, a half dozen being seen often on a couple of feet of vines, and making a very audible buzz over the whole field.

Ladybird beetles and larvæ were common throughout May, but not until the second week of June did they become abundant. I could not determine any regularity of the broods of these insects. *Coccinella 9-notata*, *Hippodamia convergens*, *H. glacialis*, *Megilla maculata*, *C. sanguinea*, and *Adalia bipunctata* were all common, the first named being the most common. Though the larvæ of these ate large numbers of pea lice between June 1 and 18, they were too late to prevent the worst injury. *Chrysopa oculata* was common, but was not nearly as valuable as the other predaceous insects. Altogether, the enemies of the lice appear too late to prevent the bulk of the injury, and as the same was true last year, it seems impossible to place any dependence upon them. It seems evident, however, that the lice are attacked by a parasite while still in crimson clover (parasitized lice were also common on red clover), but are not parasitized until they have been on peas for some time. Is it not possible the sudden appearance of the lice last year may have been due to the severe winter, which killed off the parasites and other enemies which usually hold the lice in check on the clover and so reduce their numbers that but few of them spread to peas?

The very sudden appearance of this new species last year was a unique entomological surprise. Where it came from was a question. It would seem to me that the original food plant of the pest was clover and probably crimson clover. It is true that crimson clover is not grown in the North where the louse was found destructive last year, but it is entirely possible that it may have spread from sections in which crimson clover is grown to red clover in these localities, but have been held in check by its parasites, and remained unnoticed. Furthermore, the insect enemies of red clover have at various times received study without this species having been previously noted. On the other hand, there seems to be good evidence that the louse has been on crimson clover for several years. One of our best farmers, Mr. Frank Bancroft, of Camden, Del., tells me that he has seen what he judges to be the same louse on crimson clover for at least six or seven years. In 1890 crimson clover grown upon an experimental plot at the Delaware Station became so badly infested with a plant louse that it was feared it

would be killed. Professor Beckwith's notes state (May 11, 1890) that these were exterminated by a fungous disease, and the clover was not seriously injured. Upon looking over the station collection I found specimens of *N. destructor* which unfortunately were without any label, but were among material which was unquestionably collected prior to 1896. Upon corresponding with Professor Beckwith he informed me that he distinctly remembered preserving specimens of the aphis in question. As his accession catalogue shows no such specimens to have been numbered, though by no means conclusive, the evidence is at least strongly circumstantial that *Nectarophora destructor* occurred in injurious numbers on crimson clover as early as 1890.

As regards remedies, I have practically nothing new to offer. It evidently is important to plant crimson clover as far from peas as possible, and to turn it under as early as practicable.

Brushing, followed by harrowing, was not practiced by our growers, as frequent rains made the soil too damp to make it efficient. Brushing into pans drawn between the rows did not commend itself to the growers, though it seems to me entirely practicable and I hope to see the method in use next year.

While the lice were still confined to the terminals of the late peas, it seemed probable that most of them could be killed by a spray. An attachment fitted from one-half inch gas pipe was readily and cheaply constructed so that five rows of peas could be sprayed at once. This was used with a kero-water pump and Vermorel nozzles, and gave a good spray, which covered the plants very thoroughly. Fifteen per cent kero water was found to evaporate so rapidly in the hot sun that it failed to be effective. Twenty-five per cent killed the lice and reached a large majority of them, but I feared it would injure the vines. Though they were well saturated and looked rather sick for a day or two, however, they were not permanently injured or affected. With 15 per cent kerosene an acre was sprayed twice with 5 gallons of kerosene and 2 barrels of water. One spraying with 25 per cent was much more effective and would be no more expensive. This treatment commended itself to me as cheap, practicable, and effective for use while the lice are still confined to the terminals and while the vines are still upright, at which time, if at all, the lice must be combated if injury to the crop is to be prevented. I fear, however, that the profit in pea culture to the average grower is too small for him to ever engage in spraying, though the more successful growers could well afford it.

Could the fungous disease be grown in the laboratory and started in the fields early in the season it might prove of value, but so far our pathologist, Prof. F. D. Chester, has been unable to secure its growth upon any culture tried.

APHELINUS FUSCIPENNIS AN IMPORTANT PARASITE UPON THE SAN JOSE SCALE IN EASTERN UNITED STATES.

By W. G. JOHNSON, *College Park, Md.*

For the past eight years the writer has been paying particular attention to the parasites attacking scale insects. During this period many species have been bred, but not many specimens from any particular scale. The instance cited below is, perhaps, the most important from the economic standpoint yet discovered in these observations.

Since we assumed charge of the State work in Maryland we have collected the San Jose scale on various food plants, and inclosed infested twigs, about 4 inches in length, in glass cylinder tubes open at both ends. The ends were closed with cotton, and if any parasites existed upon the scales they were easily detected and mounted for study. Only upon rare occasions have we taken more than a half dozen specimens from a single tube. This experience has been repeated year after year until the fall of 1899.

Of the four species of true parasites known to feed upon the San Jose scale, three of them have been bred in Maryland. So far as I know *Anaphes gracilis* How., bred by Dr. L. O. Howard from scales from Charles County, Md., has not been reared from this scale from any other State. *Aspidiophagus citrinus* Craw. has been reared only in California from this pest. *Aphelinus mytilaspidis* Le B. and *Aphelinus fuscipennis* How. have been reared from scales taken at the following places in this State: Riverside, Annapolis Junction, Araby, and Mitchellville. Last fall, however, I discovered a new locality for *A. fuscipennis* near Easton, Talbot County, in an infested orchard along the Miles River. The orchard contained a miscellaneous variety of fruits, and all the trees were quite seriously infested with the San Jose scale. Instructions had been given the owner to cut them down as soon as possible and burn them. A quantity of small branches incrusted with scale were brought to the laboratory and inclosed in breeding tubes. Much to my surprise these tubes were swarming with parasites a few days later. From one tube 1,114 specimens of *Aphelinus fuscipennis* were taken; while a second tube gave 432, a third 1,478, and a fourth more than 1,000, but owing to an accident the count in the case last mentioned was not exact. The writer was greatly elated over this discovery, and immediately sent out the following statement to the State press:

I am advising my correspondents not to burn twigs and branches cut from trees infested with the San Jose scale. If the tree is so seriously infested it can not be saved; it should be dug up by the roots, trimmed, and the brush and wood piled in the orchard, where they should be left until about the 1st of June or longer. If the trees are to be sprayed with either, a 25 per cent solution of kerosene and water,

whale-oil soap (2 pounds in a gallon of water), or crude petroleum, the pruning should be done first and the cut branches gathered up and piled where the spray can not reach them.

This is done to preserve the little friends nature has supplied to help keep the scale in check. If the twigs and branches are burned or sprayed the parasites would be destroyed, as they feed upon the scale insects and are now wintering under the shell-like cover protecting them. These parasites are very small, being scarcely visible to the naked eye, yet they play an important part in the economy of nature. They are wasp-like in general appearance and quite active. It would be very difficult to estimate the actual number of parasites present upon a 5 or 6 year old peach or plum tree, but it is safe to say that they would run into the millions if the parasitism was at same rate as upon the twigs in the tubes.

If I had burned these twigs I would have destroyed all the parasites. On the other hand, if I had left them on the ground in the orchard the little friends would have escaped and concentrated their attacks upon other trees where the scale had been missed by the sprays. It is clear, then, that by using a little judgment in these matters we can assist nature in restoring the balance she desires. Do not sit down and fold your arms thinking nature is going to restore this equilibrium at once; you must do your part faithfully and well. Prune your orchard as soon as possible and save every twig that contains a scale; then spray with a 25 per cent solution of kerosene and water, using any first-class spray pump, or with whale-oil soap (2 pounds to a gallon of water), before the buds open.

There is no possibility of the scale spreading until some time after the 1st of June. The young begin to appear in the vicinity of Washington, D. C., June 10 to 15 [in 1900 young were seen by the writer crawling June 3 near Washington], and the insect continues to breed until very cold weather. We have seen young, just born, on trees as late as December 19. When a twig is cut off between, say, December 20 and May 15, there is no possible danger of the scale spreading from it. It is not possible to transfer one of these insects from one twig to another after it is "set" and formed a scale over its back, and all of them die as soon as the sap is dried out of a cut twig or branch. Badly infested trees of no commercial value should be cut down now as soon as possible, before the buds open, and the brush piled. Do not leave the stump standing, as it may prove a veritable breeding place during the summer. If you are so unfortunate as to have this scale, remember that eternal vigilance must be the order of the day, and you will find before you are through with it that it is no trifling matter.

The orchard in question was not destroyed by burning, as first suggested, but the trees were pruned and the cuttings saved. In May, 1900, the writer had a large quantity of the branches from this orchard carefully packed and sent to Mr. W. W. Cobey, Grayson, Charles County; to Capt. R. S. Emory, Chestertown, Kent County, and to Hon. Charles G. Biggs, Sharpsburg, Washington County. Instructions were sent to place the infested branches in grape baskets and hang them about the orchard where the scale was most abundant. In this manner we will establish *Aphelinus fuscipennis* in the various counties and under different conditions. We have every reason to believe that the experiment will prove successful.

In this case the study of parasitism has given us a valuable suggestion for the treatment of scale infested orchards, namely, never burn a twig or tree cut late in the fall, winter, or early spring. A positive

remedy one day may be wrong the next day, just as we are able to unravel nature's secrets and interpret them for our own good.

Since the above was read the writer has tested a lot of twigs from the Charles County orchard and has bred numerous specimens of *A fuscipennis*, thus proving that a parasite is thoroughly established there.

THE BROWN-TAIL MOTH IN MASSACHUSETTS.

By A. H. KIRKLAND, *Malden, Mass.*

It is seldom possible to record with accuracy from year to year the spread of an introduced insect pest. The average working entomologist has at his disposal neither the time nor the funds necessary to follow the spreading swarms afield. It therefore follows that in such cases our records of insect dissemination have been built up by collecting and combining data in the possession of entomologists and laymen. This method is the only practicable one in the case of those insects whose spread is dependent upon the agency of commerce. Such cases do not possess the interest, at least from a biological standpoint, of those where natural means of distribution predominate.

The writer thinks the present a good time to record a few notes on the natural spread of the imported brown-tail moth in Massachusetts, particularly since the abandonment of work against this insect will prevent the accurate collection of further data.

With this insect in Massachusetts a unique condition has made it possible to follow its increasing distribution with more than ordinary accuracy. When the insect was first noticed in the State, in 1897, the work of combating it was placed in charge of the board of agriculture.

At that time the board had employed in the gypsy-moth work about 300 men, who from practical experience were fairly close observers of insect life. While it should not be understood that these men were experts, yet they were capable of recognizing the gypsy moth in all stages, and soon gained an equally accurate knowledge of the brown-tail moth, particularly after having experienced the intense nettling caused by the caterpillars. The duties of selected members of this working force included a search each fall to determine the extent of the spread of the brown-tail moth outside the area occupied the previous spring. With such employees the chance for erroneous determinations of the moth was small. The writer might add that he was able to verify the determinations in all doubtful cases.

In the paper read by Prof. C. H. Fernald before this body in 1898 a description was given of the high gale which, occurring in the flying season of 1897, disseminated the moth for many miles to the northward. This northerly spread is even more apparent at the present

time than was the case in 1898, and the greatest distribution has been in this direction. Taking the areas of the towns found to be infested from year to year, we have the following table:

Area infested, fall of—	Square miles.
1896	29
1897	158
1898	448
1899	928

While the moth was not discovered in Massachusetts until May, 1897, we were able to determine the area occupied in 1896, since this area of necessity was the same as that in which the hibernated caterpillars were found in the spring of 1897. For the same reason it is not possible to give the area occupied in 1900 until a fall examination is made.

It is interesting to note that the fall inspection of 1899 showed the presence of the moth at Seabrook, N. H., some 40 miles from the point of its introduction. Since it has now passed beyond the borders of the State of Massachusetts, any legislation looking to the control of the insect would involve cooperation of Massachusetts and New Hampshire. Indeed, Maine should be added to the list, for a small colony of the pest was located at South Berwick, Me., by Prof. F. L. Harvey, as described in Bulletin No. 61 of the Maine Agricultural Experiment Station. Infestation at this point was doubtless due to the transportation of household goods from a badly infested estate in Somerville, Mass., at the height of the 1897 outbreak.

ENTOMOLOGICAL NOTES FROM COLORADO.

By Clarence P. Gillette, *Fort Collins, Colo.*

Colorado is of peculiar interest from an entomological standpoint. The Great American Desert lying along her eastern border shuts out a very large proportion of the fauna of the Middle and Eastern States. The mountains and barren wastes beyond her western border keep back most of the fauna of the Pacific States, and the backbone of the continent rising to more than 14,000 feet in places and extending north and south forms an almost complete barrier to the intermingling of eastern and western species within the State, except in case of those which follow in the wake of civilization and which are transported by man from place to place. The insect fauna, because of the barrenness of a large portion of Colorado, is small in individuals, while the number of species, because of the great variation in climatic conditions and in plant life, is very high.

These barriers to the migration of insects have been of great service to the people, for many of the pests that are common through the Eastern States have not yet reached us. In some instances this isola-

tion has seemed to be as positive a disadvantage, and that is where insects have been imported without nature's checks being brought with them. As a result they have increased to an unprecedented extent before the balance of nature was restored.

It is my object to give you a partial bird's-eye view of Colorado's condition from the standpoint of an economic entomologist. It will be impossible to mention more than a few of the important insect enemies.

The codling moth was unknown in several fruit growing regions of the State ten years ago, but now it is a serious drawback to the successful culture of the apple in every apple-growing section of any considerable size. In the warmer portions it is so bad as to almost dishearten the orchardist, and those who do not attend well to the application of the best remedies are barely able to market any perfect fruit except of the early varieties that catch the larvæ of the first brood only. Spraying with arsenites is quite generally practiced, and white arsenic is preferred by a considerable proportion of the growers because of its cheapness and ease of distribution. Bands of burlap are quite extensively used and with results that fully warrant their continuance as a means of capturing the larvæ.

A habit of the larva that I have not seen mentioned in any publication upon this insect was reported to me last year. Mr. A. V. Sharpe, of Fruita, Colo., at the time acting horticultural inspector for Mesa County, wrote me that a neighbor had taken larvæ of the codling moth in considerable numbers under fresh bands put upon the trees early in the spring. To test how extensive this spring migrating habit is I had bands put upon trees in several localities of the State the past spring, and a small number of the larvæ were taken, but hardly a sufficient number to make it advisable to adopt this method of combating the first brood.

Another matter of considerable interest in connection with the life habits of this insect was reported at a horticultural meeting at Grand Junction last winter, and well authenticated. A gentleman, whose name I can not recall, stated that a year or two previous he selected a number of barrels of very choice apples at the time of gathering in the fall and put them in a pit for the winter. He said he took particular pains to put no wormy apples in the pit, but when he opened the pit and took out the apples late in the winter he found to his astonishment that nearly every apple had a wormhole in it. The supposition was that a late brood of moths had deposited eggs upon the apples, and that they hatched and matured larvæ in the pit.

I should be glad to know if other members of the association have met with such an instance in their experiences with this insect.

Two leaf-rollers, *Cacœcia semiferana* and *C. argyrospila*. These two species, of wide distribution over the country, have never been known

to do much harm outside of a small region situated near the foothills along the eastern slope of the Rockies in the northern half of Colorado. In this region, during the past ten years, they have been very serious pests. *C. semiferana* confines its attacks in the region mentioned entirely to the box-elder, while *C. argyrospila* is a very general feeder, being able to subsist upon the foliage of almost any deciduous tree or shrub. I have seen small orchards entirely defoliated by this species so that not a green leaf could be seen, and the box-elder species has been equally destructive to the foliage of that tree. At present these insects have nearly disappeared in Larimer County, but they are still very destructive in the vicinity of Denver and Boulder.

The case seems to be one where two closely-related insects reached, at about the same time, a region where their food-plants were abundant and their enemies scarce. As they have risen and fallen together in numbers, it seems probable that they are controlled in a state of nature by the same checks. We have bred not less than ten species of parasites from them.

The habit of the female of *C. semiferana* in shingling her egg patches with the large flat scales from the underside of her abdomen is unique among insects so far as the writer is aware. Does anyone present know of a similar habit in another species?

The peach-twig borer, *Anarsia lineatella*, has become a serious enemy in peach orchards on the western slope within the State. It has done much injury this year in pruning back the new growth on young trees, and promises to occasion a heavy loss of fruit a little later as the first brood has matured in large numbers. The most promising remedy so far seems to lie in the use of bands upon the trunks of the trees for capture of the larvæ, as in case of the codling moth.

The peach borer, *Sannina exitiosa*, is present in the peach-growing sections, but for some reason does not do serious harm as yet.

The currant borer, *Sesia tipuliformis*, is as abundant in the northern portion of the State as I have ever known it anywhere.

The woolly plant louse, *Schizoneura lanigera*, probably ranks next to the codling moth in importance as a pest in apple orchards in the State, and is particularly abundant on the west slope. Tobacco dust is taking the lead as a remedy for the root form. The number of trees actually killed by this insect in the State have been quite small.

The pear and cherry tree slug, *Eriocampoides limacina*, is very destructive, particularly to pear foliage, wherever remedies are not promptly applied for its destruction. It is worst at present on the western slope.

The San Jose scale is as yet unknown within the State. The only member of the family Coccidæ that has attracted any special attention is *Aspidiotus ancylus*, which I have seen rather abundant on several

occasions upon pear trees and which has in a few instances killed plum trees on the western slope.

The brown mite, *Bryobia pratensis*, occurs in myriads in orchards in the western portion of the State. As early as May 20 of this year the foliage of many pear, apple, and plum trees was showing very distinctly the bleaching effect of the attack of these mites. In the winter time there are portions of the trunk and limbs of the trees that are colored red with myriads of eggs that are to hatch the spring brood. The eggs are readily destroyed by strong applications of kerosene emulsion or by the lime, salt, and sulphur mixture, and the ordinary kerosene emulsion destroys the mites after they hatch.

Some farm and garden pests are as abundant in Colorado as anywhere, and among these are the imported cabbage butterfly, *Pieris rapæ*, the cabbage louse, *Aphis brassicæ*, the cabbage Plutella, *P. cruciferarum*, the pea weevil, the squash bug, the onion thrips, and cutworms. In addition we have the bean beetle, very destructive to wax beans, and other enemies of less importance.

The beet army worm, *Laphygma flavimaculata*, made a very interesting record for itself last year in localities in the State where sugar beets were grown. I can not find that the insect has ever been reported as an injurious species before.

Specimens sent to Prof. J. B. Smith were named for me as above, and I afterwards found that there were specimens of the moth in the collection that had been taken at night at Denver and at Boulder.

My attention was first called to the insect as a beet enemy by Mr. C. E. Mitchell, with the Colorado Sugar Manufacturing Company, Grand Junction, Colo. Mr. Mitchell first wrote to another person, about the 20th of July (the letter never coming into my hands), stating that a worm had appeared in considerable numbers upon beets in portions of Grand Valley. On July 29 Mr. Mitchell wrote, saying: "The worms have disappeared almost entirely during the past week. They seem to have gone into the ground." On the 12th of August a telegram was received from Mr. Mitchell stating that the worms had again appeared, and asking me to go at once to investigate the matter. This I did. The caterpillars were scattered to some extent over the entire area planted to beets, but the chief injuries were upon newly broken ground between Grand Junction and Palisades. Not less than 200 acres of beets had their leaves badly stripped, and fully half this acreage was so badly eaten down that the crop was not worth harvesting. When the beet leaves were devoured, the caterpillars ate in just beneath the crown and then went down on the beet. In fields where the beet leaves were mostly eaten away, the caterpillars were crawling over the ground in all directions in search of food, and they seemed to be able to make use of almost any green thing for this purpose. Potatoes in some cases suffered badly, as did small fruit trees where

beets were planted in an orchard. August 16 the worms were pupating rapidly, about an inch below the surface of the ground, though there were many very young larvæ still on the beets. September 10 the moths were hatching in great numbers, and there were still scattering caterpillars on the beets. As mature ova could not be found in the female moths at this time, and no more larvæ appeared, it seems probable that the moths hibernate during winter. The sudden appearance of this insect in such numbers is almost unaccountable. For several years a few parties had been growing beets, in an experimental way, about Grand Junction, but no caterpillars had ever been seen before, so far as I was able to learn. Last year a sugar factory was erected, and a large acreage of beets was grown for the first time in that region. At Delta, a town 50 miles distant by rail, and at Montrose, 70 miles distant, where beets were also grown, the caterpillars appeared in considerable numbers, but were not so numerous as near Grand Junction. The larvæ were also sent me from Rockyford, where they were common on experimental beets, but not numerous enough to attract much attention.[1]

The Arkansas Valley forms a sort of thoroughfare through which insect pests have come to Colorado from the East. It was here we first found the strawberry leaf-roller, *Phoxopteris comptana*, which is established as a serious pest on both slopes of the Rockies in limited localities. The cucumber beetle, *Diabrotica vittata*, is a recognized pest upon melon vines about Rockyford, but seems to have done no special harm in other localities, and the melon louse, now generally distributed over the State, seems to have reached us by the same route. Other insect enemies deserve mention, but I refrain from occupying more of your time.

NOTES ON INSECTS OF ECONOMIC IMPORTANCE FOR 1900.

By W. G. Johnson, *College Park, Md.*

The apple aphis, *Aphis mali* Fab., has been unusually abundant on apples this year. It was the first pest of any consequence that occasioned much correspondence. Twigs entirely incrusted with eggs of this species were frequently sent to the office during the fall and winter. The attack this spring was very general, especially in young orchards. I also found the same insect very common upon Kieffer pears in many places. The injury to apples has been very great.

The apple-tree tent caterpillar, *Clisiocampa americana* Harr., appeared this spring on apples in all sections of the State. Many trees were entirely defoliated. In one instance I found a nest in a peach

[1] I have just received a letter from my assistant, Mr. E. D. Ball, bearing date of June 17, in which he states that the beet caterpillars have been hatching for a week at Rockyford, and that in some fields the beets are half eaten up now.

tree where the caterpillars had been feeding. This was the first and only colony of these insects observed by us injuring peaches.

The asparagus beetle, both *Crioceris asparagi* Linn. and *C. 12-punctata* Linn., were present this season in the asparagus-growing areas. The former species was very conspicuous, especially on young asparagus beds, in which much damage was done. The latter species was seen only three times during the early part of the season. Hand picking of the beetles was resorted to in most cases where young beds were attacked.

The bean leaf-beetle, *Cerotoma trifurcata* Forst., which we first observed in this State in 1896, was again very destructive to wax and Lima beans throughout the trucking areas. The early varieties were more severely injured than the later ones. Paris green in land plaster, at the rate of 1 pound in 80 to 100 pounds, dusted over the plants as the leaves expanded, proved an effective remedy. This was repeated two or three times at intervals of a week or ten days.

The black aphis of violets, *Rhopalosiphum violæ* Perg., was discovered in two greenhouses doing serious injury to violets.

The clover-leaf weevil, *Phytonomus punctatus* Fab., was very common over a large area of the State. Clover was injured to a considerable extent early in the season, and many growers were apprehensive about the safety of their crop. A fungous disease, *Empusa* (*Entomophthora*) *sphærosperma*, appeared upon the larvæ, and by the middle of May it was difficult to find a living specimen. Their dead bodies were coiled about leaves, stems, grass blades, etc. The disease was widespread throughout the State, and of the same virulent character.

The Colorado potato beetle, *Doryphora 10-lineata* Say, has been a pest of a more serious character than one year ago. Paris green, applied both dry and in solution with Bordeaux mixture, has been effective.

The strawberry leaf-roller, *Phoxopteris comptana* Froel., has been observed by us doing slight damage to strawberries in Anne Arundel and Caroline counties. In both cases hand picking of the leaves was resorted to, as spraying was not desirable.

The destructive green pea louse, *Nectarophora destructor* Johns., has maintained its notorious reputation as a ravenous pest to peas, and has this year extended its ravages into the Northwest (Wisconsin). The loss estimated along the Atlantic Coast States is placed at $4,000,000 at this time (June 15); while the losses in the central West and the Northwest can not be estimated at this time. [Later: August 14 the writer received a letter from William Lorsen & Co., of Green Bay, Wis., in which they said they had planted 2,400 acres of peas, and had a fair crop upon all except the late plantings. About the 20th of July they noticed the louse upon a 500-acre field just ready to bloom, and in less than a week all the peas were dead and brown].

We have found sprays of all kinds ineffective. Our most satisfactory results were obtained when we brushed the lice from the plants and covered them with earth, using an Iron Age cultivator for that purpose. We have designated this the "brush and cultivator method." [For a more complete account of this pest see author's paper on page 55].

The fruit-tree bark-beetle, *Scolytus rugulosus* Ratz., has been a very conspicuous insect in orchard trees this season, especially those injured by the severe freeze of February, 1899.

The harlequin cabbage bug, *Murgantia histrionica* Hahn., has not been reported from any locality this season. We attribute its scarceness to the freeze of 1899.

The Hessian fly, *Cecidomyia destructor* Say, has been very destructive to all early sown wheat. Some late sowings were also injured. The fall of 1899 being very open, the fly seemed to continue its deposition of eggs much later than usual.

The imbricated snout-beetle, *Epicærus imbricatus* Say, was reported to me as injuring the leaves of cantaloupe in Washington County May 23.

The imported cabbage worm, *Pieris rapæ* Linn., has maintained its rapacious habits and done much injury to cabbage over a wide area of the State. Paris green, 1 pound in 100 pounds of land plaster, has been the most useful remedy.

The imported currant worm, *Pteronus ribesii* Scop., has been a very serious pest upon the currant and gooseberry in all parts of the State where these fruits are grown. Both Paris green and hellebore were used with satisfactory results. Hand picking was resorted to in many cases.

The Mediterranean flour moth, *Ephestia kuehniella* Zell., has been sent to me from New York, Pennsylvania, Ohio, Canada, and Australia the past season. We have found, by actual trial, that hydrocyanic-acid gas is the most perfect and effectual remedy yet tried for the flour moth and other mill pests. Large mills in Ohio, Pennsylvania, Canada, Oregon, and Texas have been successfully fumigated in accordance with the writer's directions. [For specific directions for using this gas in mills, etc., see author's articles in the "American Miller" (Chicago, Ill.), for September and November, 1899.]

The melon plant-louse, *Aphis gossypii* Glov., has again appeared in Maryland and promises to do serious damage in certain sections. [August: Was not so serious a pest as was anticipated. It was held in check by lady beetles and parasites]. Hand picking of leaves when first noticed and spraying others with 10 to 12 per cent kerosene emulsion were very effective.

The pale-striped flea-beetle, *Systena blanda* Mels., was again a serious pest to young tomato plants during the latter part of May. No satisfactory remedy has been found.

The pear-tree psylla, *Psylla pyricola* Forst., is doing considerable injury to some pear orchards in Kent County. Many trees were practically killed last season in the same orchards by this pest. No satisfactory remedy yet found.

The plum curculio, *Conotrachelus nenuphar* Hbst., while present in all parts of the State in both peach and plum orchards, is not doing serious injury. [The so-called June drop in Maryland peach belts was comparatively light this season.]

The rose-chafer, *Macrodactylus subspinosus* Fab., has been reported in one or two cases as injuring grapes on the Eastern Shore. It has not been abundant since the 1899 freeze.

The San Jose scale, *Aspidiotus perniciosus* Comst., has occupied a great deal of our attention. It is still the most serious orchard pest we have to contend with. Many new localities have been discovered by our inspections. We have found 20 to 25 per cent kerosene and water on peach just before the buds open very effective. We do not advise this strength for fall and winter on the peach. As a spring spray it has been very satisfactory in our mountain peach belt. After the fruit is gathered we will use a 10 per cent kerosene spray on infested trees. [The writer saw large blocks of peach in Georgia in July that had been sprayed with 10 per cent kerosene and water just after the fruit was removed. The scale was in most instances killed, with little or no injury to the foliage. In all cases some leaves were injured, but not enough to cause serious damage. On the other hand, however, where a 10 per cent crude petroleum and water solution was used the foliage was badly hurt and falling at the time of our visit, July 14]. As previously stated in former publications, the writer advises growers to use kerosene, even in diluted form, with every caution. It is a dangerous substance.

The stalk worm of tobacco, *Crambus caliginosellus* Clem., known also as the sooty corn-root webworm, has been conspicuous in young tobacco, especially upon grass or sod lands. No satisfactory remedy has been found as yet. Planters should avoid setting tobacco on sod land.

The striped blister beetle, *Epicauta vittata* Fab., as usual, has been quite a serious pest in tomato and potato fields. In one instance it destroyed a field of beets.

The striped cucumber beetle, *Diabrotica vittata* Fab., has been quite common in cantaloupe fields. No satisfactory remedy found.

The white-marked tussock moth, *Orgyia leucostigma* S. & A., as last year, has appeared in considerable numbers upon shade trees in Baltimore.

GENERAL NOTES.

In addition to the above, the potato-stalk weevil, *Trichobaris trinotata*, has been quite prevalent in the State in potatoes.

Pemphigus acerifolii Riley, reported by me as doing injury to maples at the Agricultural College in 1898 and 1899, has been quite

abundant this season. The pest disappears about the first week in July.

The bagworm, *Thyridopteryx ephemeræformis*, has been a serious pest in many places in the State to arbor vitæ, apple, and locust. In two instances it injured apple trees in the nursery rows. Hand picking was very effectual.

The black peach aphis, *Aphis prunicola*, was quite abundant in some young peach orchards in May.

In three cases a June beetle, *Anomala binotata*, was reported as eating the foliage from pear and apple trees.

The red-legged flea beetle, *Crepidodera rufipes* Linn., was sent to me from three localities where it was found injuring the foliage of young peach trees. The trees in all cases were planted on newly cleared lands.

The American elm scale, *Chionaspis americana* Johns., was sent to me from Geneva, N. Y., and from Ames, Iowa, upon elm.

An undetermined species of *Lecaniodiaspis* was found by the writer in Baltimore County upon wild honeysuckle (Diervilla).

An undetermined species of aphis and cutworm was found doing serious injury to lettuce in a greenhouse in Montgomery County.

INSECTS OF THE YEAR IN OHIO.

By F. M. Webster, *Wooster, Ohio.*

In point of destruction the Hessian fly outranks every other insect, when considered in connection with the wheat crop of 1900. It is doubtful if there will be over 20 per cent of an average crop in Ohio; the remaining 80 per cent may be largely charged up to the ravages of this pest. As an average crop in Ohio amounts to, approximately, 40,000,000 bushels, the loss may be computed at 32,000,000 bushels, which at the ruling market price would mean a loss of $22,400,000, at least three-fourths of which, or $16,800,000, can justly be charged up to the ravages of the Hessian fly. More extended studies of this outbreak and some of the meteorological phenomena connected therewith are given in another paper. The unprecedented abundance of the pest this year may be attributed largely to the almost total lack of parasites, the retardation of the fall brood over the northern half of the State, and the extremely favorable weather during the autumn of 1899, which enabled all but the very latest deposited eggs to hatch and the larvæ develop to the "flaxseeds" and thereby defy the adverse influences of winter. In many localities the later sown wheat escaped fall attack, and up to May 1, 1900, was uninjured, but the flies developing in the earlier sown fields seemed to have migrated *en masse* and settled down on those sown later, and the result is that in many cases the destruction is as complete in the one as in the other.

During the fall of 1899 the fall army worm, *Laphygma frugiperda*, committed serious depredations in southern Ohio, especially in Washington, Gallia, and Scioto counties. During March of the present year complaints came from the same section of the State, setting forth the continued ravages of this pest. As this seemed improbable, an assistant was sent to investigate the matter. That there was being considerable injury done in fields of young wheat there appeared to be no doubt, and an ample supply of the depredators were secured, but, instead of the supposed *L. frugiperda*, the pest proved to be no other than the spotted cutworm, *Noctua c-nigrum*, the larvæ having evidently lived over in the fields, probably above ground. I clearly recollect finding the larvæ of this same species feeding on young wheat in the fields during a January thaw at Lafayette, Ind., a number of years ago.

Early in May of the present year there came complaints of the attack of cutworms on the extensive onion farms in Hardin County. A personal investigation of these complaints resulted in my observing two separate invasions, the depredators being *Carnedes tessellata* and *C. insignata.*

The worms ranged in length from nearly three-fourths inch downward to about one-fourth inch in length. In one case they were making their way from a tract of ground which had been planted to corn last year and had been somewhat neglected and grown up to weeds, though there were almost none of these growing there at the time of my visit. The other outbreak had originated near where a large lot of potatoes had been pitted last fall and remained there over winter. Here, too, there was no vegetation on which the worms could have subsisted up to this time. The cutworms in each case would follow the rows of young onions, taking nearly every one as they went, in one case invading the field at the ends of the rows and in the other along one side. Larvæ brought to the insectary fed on red clover, the adult moths appearing largely on June 16, but others continued to put in their appearance for several days.

A mixture of wheat bran and arsenic, mixed into a dough with sweetened water and this placed under boards laid down in the midst of where the worms were at work, proved very effective and soon reduced their numbers.

It is not often that the wheat wireworm is known to attack other grains. An instance, however, was brought to notice this spring where a wheat field that had been hopelessly ruined from the attacks of Hessian fly last fall had been plowed up this spring and planted with corn. May 28 the owner of the field, Mr. E. R. Emerich, of Greenville, Ohio, wrote me saying that the corn had been badly injured by these worms, specimens of which accompanied his letter of complaint.

One of the most serious outbreaks of the corn billbug, *Sphenophorus sculptilis*, occurred in a field of timothy of three years' standing, containing 35 acres, which was broken during March of the present year, and on the 13th of May was planted with corn. June 6 the owner came to me with specimens of this beetle, claiming that the corn over the entire field had either been killed outright or hopelessly ruined from attacks of this pest. A visit to the field a few days later revealed a state of affairs that had not been overdrawn by its owner, with the exception of a few acres along one side, over which it was represented the timothy had been killed out by some unknown cause and redtop had taken its place. Here the injury had been very slight, but through the remainder of the field the damage was almost total. The owner had noticed that much timothy the year before whitened and died, but had not learned the cause. On examination I was able to find a considerable abundance of the timothy roots that had been hollowed out, clearly by the larvæ of this insect. While slight injuries by this pest are not uncommon in Ohio, Indiana, and Illinois, I never before saw so large a field of corn so thoroughly and effectually destroyed by these insects. In this case the only thing it seemed possible to advise was the replanting of the field between the old rows, leaving the remnant of the first planting to engage the insects during the remainder of their life, and thus, as it was hoped, to keep them away from the second planting.

Onion thrips, *Thrips tabaci*, were excessively abundant in some localities last year. In order to learn something about the winter habit of this insect frequent visits were made to onion fields where it occurred in greatest abundance during the fall of 1899. These visits were made during the entire winter whenever the weather was suitable, the result being that the insect was found in matted blue grass and in the piles of refuse onions that had been left in the field, but more especially in the matted grass along ditches. It was found to winter over in all stages except that of the egg. A study of the various onion fields in northern Ohio has shown that where the surroundings have been kept free of matted grass and largely cultivated there has been the least injury from these insects. The fact that it winters over in several stages of development fully explains the difficulty of tracing out generations in the field. On one extensive onion plantation that has heretofore been intersected by open ditches, the banks of which were grown up with blue grass, the experiment of destroying this grass is being carried out. As the field is situated on muck land it was, of course, impossible to burn these grassy banks over in the ordinary way, and therefore they were first sprayed with kerosene while the ground was still frozen and then fired. Either by this means or by plowing all of the grass along the banks of the ditches has been destroyed, and will be prevented from growing the present

season. From all of the information we have at present obtained it would seem as though outbreaks of this pest may be largely prevented in this way, and it has been demonstrated by actual experimentation that the insect can be destroyed by spraying the plants along the edges of the fields when they first begin to show the effects of attack with a mixture of 1 pound of whale-oil soap dissolved in 8 gallons of water.

Although this thrips in Russia is a tobacco insect, it invariably declined to feed upon tobacco with us, and held strictly to the onion. Lest I might be mistaken in regard to the species, specimens were submitted to Mr. Pergande, who compared them with Russian specimens, and informed me that there was no doubt but that we were dealing with the true *Thrips tabaci*.

In early April, 1897, the writer found adults of *Myochrous denticollis* attacking young corn in the fields in Tensas Parish, La. No serious injury, however, seemed to follow, and this, so far as known to me, is the only published record of the food habits of the insect. On June 2 Mr. Alva Agee, of Cheshire, Gallia County, reported that the insect had attacked the young corn in his neighborhood, apparently working serious injury. Specimens of the beetles were sent with the complaint. On June 4 my assistant, Mr. Newell, was sent to the locality to investigate the outbreak, and found that the territory infested comprised all the cornfields contained in an area of 3 miles square. In all cases the infested cornfields were upon land which had been the year previous either in pasture or lying out wild. A very few of the beetles were found upon blue grass. In the insectary, however, they seemed to prefer corn first, next timothy, and lastly the blue grass. In this case the beetles were not observed to feed upon the stems of the corn plant below the surface of the ground, but upon the leaves and leaf sheaths. The feeding was done during the morning and evening, or upon cloudy days. When there were drifting clouds the beetles would come out and feed while the sun was under a cloud, but go back into their hiding places in the ground when the sun came out bright and warm. During the day they were observed to hide in the crevices of the soil and in the loose dirt near the corn plants, from 2 to 15 being found in close proximity to the different hills. The beetles are densely punctate on the back, and these cavities retain more or less of the soil, which gives the beetles the same general color as the ground. They seem to have no inclination whatever to fly, but run quite rapidly. One female that was dissected contained 5 yellow, cylindrical eggs, estimated to be about 1 mm. in length.

It would therefore appear that the insect is one that feeds upon, and probably its larvæ also develops upon grass. In the latter stage it appears to be of subterranean habits. At present no remedial or preventive measures have been tried.

The destructive pea louse was found in various parts of the State during October, 1899. On the grounds of the experiment station at Wooster it was destroyed in myriads by the fungus *Empusa aphidis*, as determined for me by Dr. Thaxter. Owing to the destruction that this insect has caused along the Atlantic coast it was watched for with a great deal of interest at the beginning of the present season. A small field was sown with oats and the Canada field pea during April, but no specimens of the insect could be found upon the peas until May 30, when a single winged female was found with a number of young upon the vines. At the same time, what appeared to be the same insect was found in greater abundance upon the red clover, growing also on the station grounds. Specimens both from the pea and the red clover were determined for me by Mr. Pergande, through Dr. Howard, as *Nectarophora destructor*. This coincides with a suspicion that I have had since the pest first came to notice in Maryland and through the Atlantic Coast states, namely, that the same thing occurred here in Ohio upon the red clover.

Last fall, however, we tried to colonize individuals taken from the Canada field pea and placed upon red clover, but failed in the undertaking. Although this was not conclusive evidence, nevertheless it seemed to some extent to discredit the idea that the aphis on the clover and the one on the pea are the same; besides, I had fresh in my mind the experience with the tobacco thrip, as previously stated.

The first report of serious injuries from this pest came from a firm of growers and packers of vegetables, Messrs. Sears & Nichols, of Chillicothe, who, under date of June 12, report attacks from the insect and severe damage in a few spots in their fields of growing peas. On the station grounds the louse is being destroyed in considerable numbers by a species of Praon.

On the 17th of June, 1898, there came a complaint from Flushing, Belmont County, of serious injury to the ripening strawberries. Mr. Mally, my assistant at that time, was sent to investigate the matter. Specimens of the bug *Myodocha serripes*, had been sent by the owner of the premises as the probable depredator. Mr. Mally was not able to solve the problem, but saw at once that the injury must have been due to the attacks of an insect with a biting mouth, as it did not appear to depredate especially upon the pulp of the berry, but upon the seeds, the hulls of which were invariably thickly strewn upon the ground or fallen leaves underneath the injured berries. There was also a similar complaint from Greene County, and this was also accompanied by specimens of the same insect. Nothing was heard of this trouble last year, but June 11th of the present year I received a telegram from the owner of the premises at Flushing, to the effect that the insects were again at work upon his strawberries. A personal visit to the locality very soon developed the fact that the cause of the damage, which was

severe, as it had also been in 1898, was due to the attacks of a large black beetle, *Harpalus caliginosus*. Years ago I recorded the fact of this insect attacking the seeds of ragweed, but it has usually been considered predaceous, and therefore beneficial. The beetle seems not to care at all for the berry, either green or ripe, but in extracting the seeds it leaves the ripe berry a pulpy mass that is absolutely worthless, while the younger berries are so gnawed upon the surface as to prevent their maturing. Wherever the clusters of injured berries were found in the field one or more of these beetles was to be found in the near vicinity, generally hiding away under a clod, a small stone, or in holes in the ground. An examination of the stomach of freshly caught beetles showed a vast amount of the softer portions of strawberry seeds reduced to small bits. In no case did the hull of the seed appear to have been eaten. The beetles are large and conspicuous, easily trapped and killed when it is once known that they are the authors of the mischief, but in every case where this injury has been reported to me, specimens of the Myodocha have accompanied the complaint. I have already received other reports of this injury from the same vicinity. One of the persons who has suffered from the ravages of this insect states that they worked very badly on his premises in 1898, but not very severely in 1899, but this year again they are seriously destructive. Burning the patches over does not seem to be effective. From the fact that the Hemipter has always accompanied the first complaints of this trouble, I am wondering if the published reports of its injury in other States have not really been due to the work of the Harpalus.

On August 28, 1899, while Mr. Mally was inspecting a small nursery, he found what he took to be larvæ of the round-headed apple-tree borer, working in the bases of young linden trees. These were transferred to a breeding cage in the insectary. June 15 of the present year it became necessary to move this cage and in the badly eaten and partially decayed wood about 4 inches below the surface of the ground, active larvæ were found. On April 3 of the present year there emerged from one of these stumps an adult *Saperda vestita*. April 4 the material still remaining in the breeding cage was examined, and one larva and one pupa were found still in the wood. The larva had worked in the wood and tap root entirely below the surface of the ground, the upper limit of the work of the larva being from 2 to 4 inches below the point that marked the surface of the ground where the trees had been growing. When ready to pupate the larva seems to bore upward in the wood to what would be about on a level with the surface of the ground, and pupates in a cell cut diagonally across the grain of the wood at an angle of about 45 degrees to the upward channel. This insect has always been known as attacking the linden, but I believe this is the first record of its being found attacking trees below the surface of the ground.

Monarthrum fasciatum has been sent me the present year in the adult stage boring in both bark and wood of the maple.

Eriococcus azaleæ occurs quite abundantly this year on *Rhododendron catawbiense*. The shrub had been growing on the station grounds since 1897, therefore, it had stood one more severe winter, that of 1898–99. The shrub was isolated and the insect not at all likely to have been introduced since it was planted.

Colaspis brunnea has been excessively abundant this year and has been reported as destroying young buckwheat and beans. I have also noted it attacking four-o'clocks.

Pseudoccocus aceris has attacked the hard maples, *Acer saccharina* to quite a serious extent in New Philadelphia. No other variety of maple was injured.

NOTES FROM CALIFORNIA.

By C. W. Woodworth, *Berkeley, Cal.*

This being, I believe, the first time a member from California has attended a meeting of this Association it will be quite appropriate to give a general account of the entomological situation in the State rather than the usual notes on the insects of the year.

California is not comparable with any other one State, for there are included within her boundaries nearly as many climatic conditions as are found in all the remainder of the United States.

The great agricultural region of the State is a large valley surrounded on all sides by mountains. The Sacramento River flowing from the north and the San Joaquin from the south meet and empty their waters in the Bay of San Francisco. This valley is the region of our greatest grain fields, orchards, and vineyards. Cut off as it is by mountains from adjoining regions, not only does it form a unit as regards its climate but the native fauna and flora are quite distinct. Fortunately most of the native insects are developed for vegetation of a more or less desert type and few have made themselves felt by their injury to cultivated plants. A few cutworms, some native beetles of several kinds, but with habits of the eastern Macrodactylus, and two or three species of migratory grasshoppers from the surrounding highlands are the most abundant, though small local injury is occasionally done by many species.

There is some variation in the great valley. It is well watered to the north and along the eastern side, becoming quite a desert in the south and west, except as reclaimed by irrigation. The largest irrigation systems in the State water the southern portion of this valley. The trough of the valley is more or less frosty, but along the foothills and in the south, even partly on the plains, there runs a thermal belt on which oranges are grown to perfection. Still higher up on the hills these are replaced by the hardier fruits of the temperate zone.

Southern California is separated by a range of mountains into a comparatively narrow fertile coast region and a dry interior valley, consisting of a high plateau, northward the Mohave Desert, and southward the low Colorado Desert, dipping in one place below the level of the sea. There is also an insignificant fertile strip along the Colorado River which is quite tropical. The coast region is the California mostly known to Eastern people. Here is where the great orange and lemon orchards are found. The summers are not as hot as are those of the great valley to the north, because of the influence of the ocean. Thus the shipping of early fruits is from the north to the south; even oranges, which ripen in winter, are being shipped from northern California fully a month earlier than from southern California. The insect fauna of this region is enriched by many Mexican forms, and differs strikingly from that of the great valley. Economically, most of their problems are as different as are their practices.

The central portion of California, along the coast, consists of numerous valleys, each famous for the perfection of some product. The apple, prune, and wine grapes, for instance, are here at their best. South from San Francisco the insect fauna is very distinctive, with numerous peculiar local forms, some of considerable economic importance, while north of the bay the fauna shades off on the one hand with that of the great valley, and on the other with the north coast region.

The northern part of the State is mountainous or high lava beds. To the eastward and along the coast is a rather narrow fertile region having very heavy rainfall. Here dairy interests predominate. The fauna is practically the same as that of Oregon.

To bring out more strikingly the economic significance of these divisions, let us now review some of the more injurious insects.

SCALE INSECTS.

Scale insects have attracted more attention in California than has any other group. The most injurious species at the present time is the black scale (*Lecanium oleæ*). In the south it is most troublesome on oranges and lemons, although it is also bad on olives and deciduous fruits. In the north it is injurious to olives and deciduous fruits in the coast valleys only, scarcely appearing in the great valley, which seems to be too dry for it. It is chiefly against this insect that fumigation with hydrocyanic-acid gas is practiced, but only as it occurs on citrus trees. On deciduous trees resin-soap wash in winter is chiefly depended upon, but it is unsatisfactory on citrus trees. On these trees fumigation has come to be considered the only remedy. Some time ago a good deal of stir was made about the work of an Australian ladybird (*Rhizobius ventralis*), and possibly all present may not know that it has in no way duplicated the results produced by the *Vedalia cardinalis* on the cottony cushion scale (*Icerya purchasi*). The other

orange scales have given trouble only in the south, and are also controlled by fumigation.

The San Jose scale (*Aspidiotus perniciosus*) is still with us in California, but is so well in control that it is scarcely ever mentioned when discussing injurious insects in conventions or meetings of farmers. It occurs all over the State, but is chiefly to be found in the great valley. The treatment almost uniformly adopted is winter spraying with lime, salt, and sulphur mixture. The idea that it is troublesome only in the north is not correct.[1] It is less injurious near the coast (San Jose and southern California) than in the interior (Marysville), but it is rather more injurious in the San Joaquin than in the Sacramento valleys. The use of the lime, salt, and sulphur mixture is so beneficial to the tree that it is often used when the orchard is free from scale. Our very dry, hot summer weather has a tendency to unduly thicken the bark much as the attacks of the scale insects do, and nothing we know of in the way of a bark corrodent is as safe and effective, leaving the bark in so perfect a condition as this. The wash does not kill the insects, at least not very completely at once, but perhaps as much by the corrosion of the bark as anything else effectually rids the tree of the insects attached to it.

CODLING MOTHS.

The codling moth, next to scale insects, has received attention. It occurs over most of the State and presents a most diverse set of life histories according to the location. In some places it is still unknown (isolated orchards along the Sierra foothills); in others, while present, it is so unimportant as to require no treatment (several localities exposed to the ocean winds).

Again, in a good many localities the insects come late in the spring and perhaps have but a single brood, and one spraying any time before the fruit is half grown seems to be satisfactorily effective. A still larger number of localities require the spraying to be once carefully done and properly timed for early fruit, and two or three additional sprayings late in the season if late fruit is to be saved. Finally, some situations are so bad that a continuous warfare must be kept up from the time the blossoms open till the fruit is picked. Indeed, some of our fruit, especially fancy apples for export, is picked over two or three times after storing in the packing house to allow the development of worms that could not be discovered at picking time.

PEACH WORMS.

The peach worm (*Anarsia lineatella*), which winters as a borer in the bark, becomes a bud worm in the spring, and in the second generation bores into the ripe fruit, is one of our most troublesome peach

[1] J. B. Smith, Rep. State Ent. N. J.

insects. It shows some of the same peculiarities as to abundance and ability to do injury, but in some regions, as at Berkeley, is practically unknown.

The Eastern peach borer, as well as the curculio, has not found as yet a home in California. The former has without doubt been many times introduced into the State on nursery stock. Why they have not become acclimated is very difficult to understand. We have a native peach borer, *Sannina pacifica*, belonging to the same genus and with the same habits, which in its distribution is quite as mysterious. This insect makes its home in the neighborhood of San Jose and has undoubtedly, even to a larger extent than the Eastern species, been sent in nursery stock over the State, but it is still quite unknown except in that one region, where it is quite as much a pest as the *S. exitiosa* has ever been in the East.

GRAPE INSECTS.

Since California is the only region where the European grape is grown, it is only with us that the phylloxera is an important insect. Vineyards have been destroyed over whole valleys, as occurred in Europe, but the insect proves to be very much slower in spreading than in Europe, which corresponds with the difference in life history in California. The winged form, being produced only after long intervals, apparently requires conditions which in most years do not occur.

Next to the phylloxera the vine hopper (*Typhlocyba comes*) (ours is a variety somewhat intermediate between *coloradensis* and the typical *comes*) is injurious only in the great valley and in the coast region north and west of San Francisco Bay. In the early spring it often comes in such immense numbers as to cause the distortion of the young leaves by the partial atrophy of the vine, causing them to have something the appearance of curled leaf lettuce. After the first leaves have become mature they insert their slender curved eggs just under the cuticle of the leaves beneath, and young are produced from then on continuously till the leaves fall. By autumn, if nothing checks them, they are more numerous than I have ever seen them in the East. They are abundant enough every spring to easily destroy all the foliage before the season is over, but through disease or other calamity, exactly what, I have never been able to satisfy myself, their numbers are usually reduced so that it is possible to raise grapes.

The remedy usually suggested for vine hoppers is winter "cleaning up," but the usual practice in most parts of our vineyard districts is to clean up more thoroughly than would be thought possible in the East. It is certain that the clean vineyards are most injured by the hoppers in the spring, although by midsummer little difference can be noticed.

Another vine hopper belonging to a different subfamily, and I

believe the only member of its genus ever becoming seriously injurious, is *Tettigonia circillata*. It is as injurious and in every way entirely replaces the small vine hopper in the Santa Clara Valley, and while occurring all over the coast region southward is nowhere troublesome. It differs from the Typhlocyba in breeding in the winter and on other plants as well as on grapes in the summer time.

It is not necessary to bring up further examples to show how clearly the distribution and habits of insects depend upon their environment, and the necessity in a region of such diversity as California of making local investigations before having any sound basis for economic practice.

NOTES FROM CANADA.

By JAMES FLETCHER, *Ottawa, Canada.*

The economic entomologist has had full opportunity this spring of studying injurious insects in all parts of Canada. Owing to the attention which has been directed to the subject by legislation connected with the San Jose scale and other injurious insects, many people have noticed insect injuries which otherwise would have been overlooked.

An important concession was made by the federal government last spring in allowing nursery stock to be imported into Canada subject to fumigation in houses specially prepared and in charge of a government officer.

Tent caterpillars of the two common species, which during the last three years have been extremely abundant in eastern Canada, were noticeably less destructive. Although many hatched in some places, they disappeared suddenly and few produced the perfect insects. The cause of this sudden disappearance was not detected in most cases.

Leaf rollers on apple trees were very destructive toward the end of May in orchards along the northern shore of Lake Ontario, the two commonest species being *Lophoderus quadrifasciana* and *Cacœcia rosaceana*. Both of these insects are common at Ottawa and have done a considerable amount of harm for several years, but they have been particularly abundant this summer. In 1891 and 1892 apple trees on the experimental farm were almost denuded in the spring. The larvæ of Lophoderus eat the green portions of the leaves, reducing them to masses of dirty white down, the pubescence from beneath the leaves, and fragments of leaves. Another injury to apple trees of some interest which has been complained of this year rather more than usual is an attack upon the flowers by the click beetle *Corymbites tarsalis*. The beetles eat holes into the petals and destroy the essential organs as well. *Micropteryx pomivorella*, usually a rare insect, has been found in considerable numbers in the Niagara district, and specimens have also been sent from Nova Scotia. The curious little cocoons in some instances have been sent in as scale insects. They

bear a slight resemblance to some species of Lecanium. The oyster-shell bark louse, in most parts of Canada a serious enemy of the fruit grower, has been much reduced in numbers by the parasite *Aphelinus mytilaspidis*, which has been at work all through the Niagara district. Experiments have been tried with several of the usually recommended remedies for the oyster-shell bark louse, and the results of some experiments with a simple lime whitewash, which have been carried on by Mr. W. T. Macoun, horticulturist at the Central Experimental Farm, are worth mentioning. When spraying trees with whitewash to retard the opening of the flower buds, Mr. Macoun noticed that the bark lice were killed and scaled off in large numbers from the trees as the whitewash fell, and from present appearances the results of spraying fruit trees infested with the oyster-shell bark louse are such as to indicate that this will prove a valuable, simple, and inexpensive remedy.

ROOTS AND VEGETABLES.

The most troublesome insects this season under this head have been the root maggots of the onion and cabbage. Many remedies have been tried, but nothing actually new has been learned. The Gough tarred-paper disks have been very successfully used, and for cabbages and cauliflowers with more satisfaction than anything else. These have been fully described by Mr. Slingerland. Among the insect enemies of the pea, the pea weevil (*Bruchus pisorum*) is still abundant in some parts of Canada—a fact, I think, due to greater negligence on the part of seedsmen in treating seed than was formerly the case. The destructive pea aphis has not yet made its reappearance in Canada this season. The white cabbage butterfly (*Pieris rapæ*), every year the cause of much loss to cabbage growers, has now reached Vancouver Island, and thus extends from the Atlantic to the Pacific. The red turnip beetle (*Entomoscelis adonidis*) has appeared rather earlier than usual in the Northwest, where it attacks all cruciferous plants. It is particularly attracted by the wild crucifers, *Sisymbrium incisum* and *Erysimum inconspicuum*. Although no serious loss has as yet been reported from this insect, with the gradual settling up of the prairie provinces it is to be feared that this will become a serious pest of cabbages, turnips, and radishes.

CEREALS.

One of the serious outbreaks of the present season is by locusts (*M. spretus* and *atlanis*) in Manitoba, which hatched out remarkably early this year, namely, by May 20, and owing to the exceptional drought have already done much harm to crops. Cutworms have also been abundant in wheat fields. A new attack of much interest in the wheat fields of Manitoba last year was by the Hessian fly, which reduced the crop from 5 to 25 per cent in different places. Another of the old-

time enemies of the wheat plant also showed up again last year in two or three parts in Canada, namely, the wheat midge (*Diplosis tritici*).

Of mill insects the Mediterranean flour moth continues to be troublesome, and an interesting occurrence was found a few miles from Ottawa, where the insect in a badly infested mill was abundantly parasitized by a small Limneria, probably *L. fugitiva*. The ordinary meal moth (*Pyralis farinalis*) was the author of considerable loss in stored grain at one locality in Manitoba.

FODDER PLANTS.

The clover weevil (*Phytonomus punctatus*) has as usual been found in one or two places along Lake Ontario this spring, but, as has always been the case with us in Canada, was quickly wiped out by the fungus *Entomophthora phytonomi*. A far more general and destructive insect to clover with us is the lesser clover weevil (*P. nigrirostris*). Three or four occurrences have been reported in the Province of Ontario of the clover-root borer (*Hylastinus obscurus*), but the loss has not been great.

TREES AND SHRUBS.

Probably the items of the greatest interest under this heading were the abundant occurrence in Manitoba and the Northwest of some insect enemies of the ash-leaved maple (*Negundo aceroides*), the Negundo gall gnat. The fleshy galls of a cecidomyiid-like larva were found in enormous numbers on the young leaves in June. Wherever this tree had been planted for shade or ornament throughout Manitoba and as far west as Indian Head, the trees were much disfigured. There appears to be only one brood in the year. Occurring on the same trees were the larvæ of the cankerworm (*Alsophila pometaria*), which in many places stripped the trees of leaves. This is a constanly recurring enemy of the ash-leaved maple in Manitoba. Another serious enemy of this much burdened tree is the aphid.(*Chaitophorus negundinis*), which renders the trees filthy by reason of its copious honey dew and the black fungus which grows upon it, Fumago. The larva of a small moth also causes swelling in the twigs while green and subsequently most of these twigs are permanently injured. The moth was identified by Dr. Riley as *Proteoteras æsculana*.

There are of course many other insects which might be mentioned, but these are the most interesting I can think of at the present moment.

All the papers having been presented, the following discussions took place:

Mr. Woodworth called attention to a method of combating the codling moth frequently used in California. He stated that the California growers at the time of cultivating their trees in the fall frequently

banded the trees with cloth or straw, and that these bands serve to collect the codling-moth larvæ, which were then destroyed.

Mr. Gillette had observed the larvæ of this insect migrating on the tree trunks in the spring, contrary to what was supposed to be their usual habit. He had observed the larvæ leaving their winter cocoons and moving about on the tree trunks at this time. In his opinion banding the trees in the spring was a valuable means for fighting the insect.

Mr. Johnson, in explanation of the common name of *Nectarophora destructor*, stated that this name had been decided upon jointly by Messrs. Pergande, Chittenden, and himself; that while the name was perhaps open to criticism, it was probably as appropriate as any. He also called attention to Mr. Lounsbury's statement that the red scale occurred on other than citrus trees in South Africa, which fact is of great importance and worthy of emphasis.

Mr. Lounsbury said that the red scale was a very common pest on the pear in South Africa, that it had an extremely wide range of food plants, and that its effect on growing wood was similar to that of the San Jose scale.

Mr. Felt, discussing the matter of common names of insects, expressed the opinion that a strict enforcement of the law of priority is hardly practical in such cases. It is difficult to change a well-established common name, however inappropriate it may be. He cited the failure of an attempt to change the common name of *Clisiocampa disstria* from "forest tent caterpillar" to "forest tentless caterpillar."

Mr. Fletcher felt that entomologists were open to grave criticism in not establishing appropriate common names for injurious insects. He suggested the appointment of a committee to secure uniformity in common names of insects.

Mr. Woodworth, referring to an experience in this line in California, stated that the board of horticulture of that State had formally voted to call *Aspidiotus perniciosus* the "pernicious scale," but in spite of their efforts to secure a standing for this name the pest was still generally known as the "San Jose scale."

Mr. Hopkins discussed at length the confusion arising from variation in common names. It was, in his opinion, highly desirable to have a uniform common name for each injurious species, similar to those adopted by the American Ornithologists Union. He also moved the appointment by the chair of a committee on common names.

Mr. Johnson, referring to the motion just made by Mr. Hopkins, called attention to the lack of system in selecting common names of scale insects. For instance, *Aspidiotus ancylus* Putnam was known as the "Putnam scale," *Aspidiotus forbesi* Johnson was known as the "Forbes scale," etc.

Mr. Kirkland thought the members were wasting valuable time on this matter of common names. Entomologists, to be most useful to their *clientèle*, must use the most common name of the injurious species under discussion, and it would be impractical to confine entomologists in different parts of the country to a single common name for an injurious species.

Mr. Lounsbury said it would be impractical to write of the "woolly aphis" of the apple in South Africa, since there *Schizoneura lanigera* was everywhere known as the "American blight," yet the name "American blight" would hardly be serviceable to the reading public in this country. In the same way the "corn worm" of the North (*Heliothis armiger*) was the "cotton-boll worm" of the South.

Mr. Fletcher considered that some arrangement to secure uniformity in common names of insects would not be impracticable, since it had been made to work well in the case of birds.

Mr. Johnson thought the scope of the committee should be confined to the establishing of common names for such new species as should hereafter prove injurious.

After the acceptance of the amendment offered by Mr. Johnson, it was resolved that a committee, to consist of Mr. Gillette, the first vice-president, and the secretary of the Association, be appointed to pass upon the common names of such injurious insects as may be discovered in the future.

Mr. Fletcher expressed a desire that the committee also be given power to remove ungainly and inappropriate names, and offered an amendment to this effect, which was accepted and adopted.

A letter from Mr. Cooper Curtice, of Raleigh, N. C., relative to the need of securing a uniform list of injurious insects for use in quarantine work was read, and upon motion of Mr. Johnson laid upon the table.

The regular routine was suspended to admit the proposal of two new members:

C. B. Simpson, of Ithaca, N. Y., proposed by Mr. Sanderson.

Henry Skinner, of Philadelphia, Pa., proposed by Mr. Hopkins.

The committee on nominations proposed the following officers for the ensuing year:

President, C. P. Gillette, of Fort Collins, Colo.

First vice-president, A. D. Hopkins, Morgantown, W. Va.

Second vice-president, E. P. Felt, Albany, N. Y.

Secretary-treasurer, A. L. Quaintance, Experiment, Ga.

The report of the committee was accepted and the officers above mentioned elected.

A vote of thanks was tendered the retiring secretary for his services during the past two years.

The report of the committee on resolutions, given below, was accepted and adopted, viz:

Resolved, That we regret the absence of the president of the Association, and that we extend to the acting president our thanks for his able address, and commend his suggestions to the consideration of all members of the Association.

Resolved, That we request the honorable Secretary of Agriculture to publish the proceedings of this meeting, and that we express to him our hearty appreciation of such action in previous years.

Resolved, That we express our thanks to Columbia University and its officers and the local committee for courtesies extended the Association.

E. P. FELT,
W. G. JOHNSON,
A. F. BURGESS,
Committee.

It was voted to hold the next annual meeting of the Association at the same place and on the two week days preceding the next annual meeting of the American Association for the Advancement of Science, which will be held in Denver, Colo., August 24–31, 1901.

Adjourned.

A. H. KIRKLAND, *Secretary.*

LIST OF THE MEMBERS OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

ACTIVE MEMBERS.

Adams, M. F., City Bank Building, Buffalo, N. Y.
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Weed, H. E., Griffin, Ga.
Wilcox, E. V., U. S. Department of Agriculture, Washington, D. C.
Woodworth, C. W., Agricultural Experiment Station, Berkeley, Cal.

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